MASS. [redacted]
UM301.2:M58
UMASS/AMHERST
312066 0278 1390 1

MICROCOMPUTER AWARENESS TRAINING

Jan P. Braverman
Arthur W. Eve

GOVERNMENT DOCUMENTS
COLLECTION
MAY 31 1984
University of Massachusetts
Depository Copy

[illegible]

MASSACHUSETTS BOARD OF EDUCATION

Donald R. Walker, *Chairperson*
John W. Bond
Millie R. Clements
Joseph P. Crimmins
James R. Grande
James L. Green
Howard A. Greis, *Vice Chairperson*
Charles T. Grigsby
Edwin M. Rossman
Joseph C. Savery
Dorothea A. Zanetti

John H. Lawson, *Commissioner of Education, Secretary*

John B. Duff, *Chancellor,* Board of Regents, *Ex Officio*

This material is a product of the Comprehensive Professional Development Project sponsored by the Massachusetts State Department of Education, Division of Occupational Education in cooperation with the Division of Special Education. The project is administered by the Institute for Governmental Services, University of Massachusetts.

The Division of Occupational Education

David F. Cronin, *Associate Commissioner*
Ralph E. Watson, *Executive Director*
John P. McDonagh, *Personnel Development Coordinator/ Project Liaison*

The Division of Special Education

Roger W. Brown, *Associate Commissioner*
Judith I. Riegelhaupt, *Executive Director*
Geraldine R. Ryan, *CSPD Coordinator/Project Liaison*

The Institute for Governmental Services
University of Massachusetts

Project Staff:

Elizabeth C. R. Chase, *Technical Coordinator*
Marilyn V. Santiesteban, *Training Coordinator*

MICROCOMPUTER AWARENESS TRAINING FOR STATE AGENCY PERSONNEL

by

Jan P. Braverman

and

Arthur W. Eve

Prepared for the

Massachusetts Department of Education

by

The Institute for Governmental Services

December 1982

THE INSTITUTE FOR GOVERNMENTAL SERVICES, founded in 1970, is a linking agency between the University of Massachusetts and state and local governments in the commonwealth. It brings academic expertise and practical experience to bear on issues affecting these state and local agencies through the provision of training, technical assistance, publications and research.

Maurice A. Donahue, Director
University of Massachusetts
250 Stuart Street
Boston, MA 02116

Arthur W. Eve, Associate Director
University of Massachusetts
Middlesex House
Amherst, MA 01003

Maureen McCarthy Johnson
Administrator of Programs
and Financial Affairs
University of Massachusetts
100 Arlington Street
Boston, MA 02125

ACKNOWLEDGEMENTS

This microcomputer awareness monograph was developed and compiled through the combined efforts of many people. First we would like to express our appreciation to Gerry Ryan and John McDonagh, our project liaisons from the Divisions of Special and Occupational Education. They provided the much needed assistance, encouragement, and advice necessary to organize and conduct the training sessions outlined in this monograph.

Thanks, too, to the planning team members who devoted so much time to planning and coordinating the implementation of these training sessions. To each of you -- Karolyne White, Beth Strassberg, Bobbi Antinarelli, Dwight Tavada, Joe Vigna, and Dina Hamilton -- your help was invaluable.

Finally, a very special thank you goes to Elizabeth Chase, the Institute's project coordinator. Much of our success in developing these training programs was the result of Tibby's talent, enthusiasm, and willingness to take on extra work. In addition, this monograph is considerably more coherent and readable as a result of her questions, insightful comments, and skill as an editor.

Typing, layout, and production was handled by our IGS staff, Jean Turati, Barbara Llamas, and Kate Mahoney.

We would like to express our sincere thanks and appreciation to all the above individuals in cooperating in this effort.

Jan P. Braverman

Arthur W. Eve

Digitized by the Internet Archive
in 2015

https://archive.org/details/microcomputerawa00brav

TABLE OF CONTENTS

I. OVERVIEW 1

II. THE MICROCOMPUTER REVOLUTION 3

III. WHAT IS A MICROCOMPUTER? 9

IV. DEFINING COMPUTER AWARENESS 17

V. THE NEEDS OF ADULT LEARNERS 21

VI. THE NEEDS OF THE ORGANIZATION 27

VII. AWARENESS TRAINING PROGRAMS 31

VIII. AWARENESS TRAINING TECHNIQUES 57

IX. DESIGN OF A TRAINING AND SUPPORT SYSTEM 71

X. CONCLUDING THOUGHTS 81

APPENDICES

A. GLOSSARY OF MICROCOMPUTER TERMS 83

B. BIBLIOGRAPHY 87

PREFACE

During 1981 and 1982, staff members from the Institute for Governmental Services provided technical assistance and training in a variety of topic areas to personnel from the Massachusetts Department of Education. This monograph evolved from the information that we began collecting during the microcomputer awareness training programs that were conducted for Department personnel beginning in February of 1982.

During the fall of 1982, the Massachusetts Department of Education began the process of selecting microcomputers for use as management and professional workstations. Department personnel in the central and regional offices will begin using these microcomputers both as self-contained computers and as terminals to the State College System mainframe computer during the spring of 1983.

Institute staff are currently involved in providing additional microcomputer related support services to the Massachusetts Department of Education. These project activities include: (1) microcomputer training for department personnel, (2) technical assistance on microcomputer and mainframe utilization to various organizational subunits, (3) consultation on issues such as the development of bid specifications for microcomputers, and (4) a monograph designed to assist local education agencies in the purchase of microcomputers.

In addition to these education related activities, the Institute contracts with other state and local government agencies throughout Massachusetts to provide technical assistance and training in the use of microcomputers. The Institute also distributes a newsletter titled Microcomputer Letter For Managers. This newsletter provides information about management applications for microcomputers and has been written for managers who have no technical training.

Further information about the microcomputer related support services that are provided by the Institute can be obtained by calling or writing:

Dr. Arthur W. Eve
Associate Director
The Institute for Governmental Services
Middlesex House, Room 220
The University of Massachusetts
Amherst, Massachusetts 01003
(413-545-0001)

CHAPTER I

OVERVIEW

This monograph began as a description of a series of microcomputer awareness training programs that were provided by the Institute for Governmental Services for the Massachusetts Department of Education during the spring and summer of 1982. These programs and some of the training techniques that we found particularly useful are described in Chapters VII and VIII. Our primary purpose in providing this information was to help others benefit from our experience as they organized similar awareness training programs.

In the process of describing what had taken place during the awareness training, we discovered that much of the information that we considered essential to the development of effective training was still missing. For example, we wanted our readers to understand some of the assumptions that we had made in designing the programs. This concern led to the development of three additional sections: Chapter IV (our definition of computer awareness), Chapter V (our perspective on the needs of adult learners), and Chapter VI (our views on the organization's needs in relation to microcomputer awareness training).

Since many of our readers are newcomers to the topic of microcomputers, we also thought that it would be helpful if we provided a non-technical description of all of the component parts in a typical system. We included this information in Chapter III (What Is A Microcomputer?) and added a glossary of terms at the end of the document for readers to use as a quick reference. A bibliography also was included for those who are interested in reading additional material on the topic.

Equally important for those readers who are not familiar with the phenomenal spread of microcomputers is a section describing the changes that have taken place in the seven short years since the first commercially available microcomputer hit the market. We called this part "The Microcomputer Revolution" and included it as Chapter II.

Through Chapter VIII, our primary concern was to provide information that would help our readers understand our approach to the task of providing microcomputer awareness training. We also realized that there was much more to the process of helping people learn to use microcomputers than just expanding their awareness and wanted to place awareness training within this broader context. This concern led to the development of Chapter IX, "Design Of A Training And Support System".

We used the last chapter to summarize and share some of our reflections on microcomputer training. Chapter X is titled "Concluding Thoughts".

This monograph has been designed in such a way that it can be read from cover to cover or used as a reference manual. We suspect that most of our readers will find that it is more useful if approached from a reference manual perspective, and that is why we have included this description of how we developed the document. We have written each segment so that it can be used quite independently of the other parts of the monograph. Thus, when you are interested in finding out about the inner workings of a microcomputer, you should read Chapter III, "What Is A Microcomputer?". When you are ready to think about how your organization can move beyond the awareness training stage, then it is time to read Chapter XI, "The Design Of A Training And Support System".

We have written this monograph for a non-technical audience and have tried to use information that we thought would be useful for several years, an extremely long period of time when it comes to the speed with which microcomputers are changing. As a result, we have not included many product descriptions since most hardware and software that is currently in use has a life expectancy of around six months before it will be superseded in performance by another product. In spite of our best attempts to structure longevity into this document, much of it will probably become dated rather quickly because of the rapid and dramatic changes that are occuring in the field. Therefore, we would like to suggest that you discard this monograph around December of 1984 (if you still have it) or, at the very least, be quite cautious about using the ideas that we have presented beyond that point in time.

Finally, we would like to hear from those readers who share our interest in the development of effective microcomputer training programs. Whether you liked what we said, disagreed with us, or think that we missed something important, your reactions and comments will be greatly appreciated. We are currently developing other monographs, articles and newsletters about microcomputers and would value all of the assistance that we receive both from our technical and non-technical readers. For those of you with parallel interests in the microcomputer training field, we will be happy to share future publications that we develop.

CHAPTER II

THE MICROCOMPUTER REVOLUTION

A high technology revolution is occuring which will reshape the way we handle information. The magnitude of this revolution can be grasped through a brief description of the short, dramatic history of the microcomputer. The first commercially marketed microcomputer was the Altair, which was introduced in January of 1975. It was available either pre-assembled or in a hobbyist's kit and dominated the personal computer market for two and a half years. By 1977 Apple, Commodore, and Radio Shack had entered the marketplace and microcomputer sales began to expand rapidly.

For the first four years, microcomputers did not have sufficient information storage space or software to be taken seriously in the world of business. The amount of available storage space increased from 4,000 characters (i.e., letters or numbers) in 1975 to around 48,000 characters by 1978. However, in 1978 most microcomputers were still purchased with only 16,000 characters of memory and the available software was not appropriate for any but the smallest business applications.

All of that changed in 1979 with the appearance of VisiCalc, the first of the electronic spreadsheets. Business applications subsequently became a major growth factor and accounted for 64% of the microcomputers that were sold in the United States by 1981. As an illustration of the growth pattern, total microcomputer sales in the United States from 1975 through 1981 were 1.2 million units while sales during 1982 are expected to exceed 3.5 million microcomputers. It is predicted that over 44 million units will have been sold in this country by 1990. In the short time since they first appeared in 1975, the use of microcomputers has increased dramatically and a wide range of software options have been developed for use in business, education, and the home.

The newness of the professional microcomputer and it's growth in the business sector means that at least for the next eight years there will be a shortage of people who are both knowledgeable about and skilled in the use of microcomputers. Regardless of their major field of expertise, people who are familiar with how to use microcomputers will be considered valuable assets to many organizations. During the next five years, many colleges and universities will probably still concentrate on teaching students how to use large computers. Institutions of higher education traditionally have been slow to purchase new equipment, many of them have recently entered into an era of serious economic difficulty, and most of their faculty members were trained on the large equipment.

Very few faculty members or other data processing experts understand that one of the major reasons for the success of microcomputers is that the user does not have to be a programmer or know very much about the internal workings of the equipment in order to use it effectively. In a way it is similar to the phase that users went through right after the automobile was invented. In those days a person had to be familiar with the internal workings of an automobile in order to drive one because cars were always breaking down and there were very few gasoline stations and fewer repair shops. Since then, automobiles have evolved to the point where all an operator needs to know are the rules of the road and how to turn the engine on. Right now microcomputers are still in the transition period; you need to know more than just how to turn it on, but you no longer need to be a mechanic or know anything about how to program the machine in order to make it do what you want it to do.

Microcomputers are being introduced into schools rapidly enough so that many of the students who are now in elementary schools will be skilled in the use of computers when they enter the job market. However, the schools will probably not begin turning out large numbers of graduates who are skilled in the use of computers for at least another eight years, the time that it will take for today's fourth graders to graduate from high school. This is in part due to the slowness with which education changes, but also because of the enormous financial cost for equipment and teacher retraining.

It will be the older generation that falls behind in the acquisition of computer literacy and skill. Many adults will continue to be uneasy about the use of computers because they are unfamiliar with how computers can be used and are also afraid of changing their old patterns of doing things. And therein lies a great opportunity for those adults who are willing to invest the time and energy to become knowledgeable about and skilled in the use of microcomputers.

Major adult retraining efforts will be needed in order to prepare people to use the 44 million microcomputers that will be placed into service during the remainder of this decade. There is probably no precedent in the history of in-service education or staff development for the scale on which computer training will take place. Of the projected 14 billion dollars in expenditures that will be made for microcomputers during the remainder of this decade, it is estimated that over 3 billion will be spent for training related activities.

As a result of the phenomenal growth in the use of microcomputers, there is considerable pressure on many organizations to train their employees in how to use computers. This publication offers some important points to consider when developing programs and processes that provide in-service instruction about microcomputers for adults. Our

efforts focus on microcomputer awareness training for professional personnel in a large state agency; however, the issues that are raised have much broader application and can be useful in developing training programs for any group of adults.

There are many reasons why the microcomputer has become an economic imperative for both private and public sector organizations. With the appearance of the microcomputer, the power of electronic data processing has become available in an individualized, desktop form. What had been a highly centralized organizational resource during the past 30 years has been revolutionized through miniaturization, reduction in cost, and simplification of use.

Many organizations have had data processing equipment for decades, but have structured its use in very specific ways. Traditionally, data processing (DP) departments have been organized in such a way that they provided priority services to the uppermost executives. DP departments have developed very special positions in their organizations by providing essential information to top managers. This has been so pronounced that directors of data processing are often more powerful (and paid better) than the vice presidents under whom they work. Being primarily oriented toward top management's information needs, the DP department in an organization has not been as aware of or concerned about the management information needs of personnel closer to the day-to-day operational aspects of the organization.

With the increase in power of the microcomputer, its ease of operation, and decrease in size and cost, it has become feasible for many organizations to place them on the desks of a wide range of both non-professional and professional staff members. The professional staff members who have begun to work with microcomputers are typically non-technical people who occupy a hierarchical position in the organization that falls below the level traditionally served by the data processing department. Use of microcomputers has spread because it is a cost effective method of dealing with the information management functions performed by many professional and support staff personnel at all levels within the organization.

Many organizations have discovered that the microcomputer can be used to dramatically increase the amount of work done by support staff members. While this might seem to be a transparent form of speeding up the work pace, both workers and their supervisors have not interpreted it in this way. Instead it is a matter of electronically organizing information that was traditionally handled through laborious manual systems, an approach that cuts down on repetitive drudgery and extends to the microcomputer's user the power to perform other tasks. Microcomputers have also been appearing on the desktops of many professional workers in an effort to

boost the productivity of these more highly paid employees. Organizations have found that increased efficiency and effectiveness at these higher salary levels offers a significant return on their microcomputer equipment investment.

As an operational tool and resource, the mirocomputer has reached a point in its development where there is a clear and positive relationship between the costs involved and the benefits derived from it's use. The productivity improvements that are possible with word processing alone have justified costs so easily that it is hardly possible in most organizational economic contexts to question the value of microcomputers. Coupling word processing with electronic spreadsheets (which permit financial modeling on the desktop microcomputer), the economic advantages have become evident to so many major organizations that microcomputers are now inextricably woven into our economy and culture.

Understandably, these economic imperatives in the larger society have generated certain educational imperatives for local school systems. Educators are faced with a need to help students use and cope with this new and pervasive technology. Unlike the audio visual equipment buying sprees that schools were involved in during the 60s and 70s, the microcomputer demands a seriousness of attention and purpose from educators. The audio-visual phase was based upon a technology that had not been integrated into business and government to any significant degree, and the use of audio visual equipment is still rather marginal decades later.

The microcomputer is becoming embedded in the day-to-day operations of small businesses as well as large corporations and government. Banks today wonder how they did business before electronic data processing equipment became available. Many organizations will soon be at the stage where they will believe that they cannot function without a microcomputer on everyone's desk. The microcomputer is clearly not a passing fad in the world of work.

School system personnel have begun to realize that they must take this phenomenon very seriously. There has been a strong local interest in moving quickly toward the integration of microcomputer technology into the educational experience of all students. Particularly this year, there have been major purchases of microcomputers by schools. Large sums of block grant money have been devoted to these purchases in school systems that have otherwise been strapped for funds. Increasingly local education agencies have been looking to their state education agencies for funding and, to some extent, for guidance about the integration of this new technology into the curricula.

On another level, the state education agency as a large organization is facing some of the same economic imperatives that confront private sector organizations. Public agency fiscal resources have diminished considerably in the last three to five years. Unfortunately, the tasks expected of these agencies have not decreased commensurate with the funding shrinkage. Those productivity boosts associated with microcomputer technology have become very attractive to public sector organizations such as state education agencies.

In summary, the microcomputer revolution is proceeding at full speed and is already having a dramatic impact on the way work is carried out in many organizations. Like it or not, microcomputers are a part of our society's future. For those of you who are not yet informed about the product that is at the center of this revolution, we have provided a description of the microcomputer in the next chapter.

CHAPTER III

WHAT IS A MICROCOMPUTER?

We are moving toward a time when a person will not have to know very much about how a microcomputer works in order to run it. You will recognize the arrival of that era when people begin to use microcomputers in much the same way that they currently use automobiles, hi fi sets, calculators and cameras.

In the meantime, there are several reasons to become familiar with some of the technical language used to describe microcomputers. First of all, many of these terms describe items that have only recently been created and, as such, the words are legitimate additions to our language. Although we probably could live the rest of our lives without ever using a term such as "microprocessor", this word performs a useful function for those who wish to describe a particular object. Second, a general familiarity with some of the technical language will help you understand how the microcomputer works and this knowledge will begin to demystify the magic that many people associate with the computer. Finally, many of the computer experts upon whom you will rely during the next few years need to use some technical terms in order to tell you what they know about microcomputers. It is your responsibility as a competent professional to be able to communicate effectively with these experts.

Although you may initially be overwhelmed by the technical terms, you don't have to learn everything at once. Another thing to keep in mind is that knowledge about microcomputers, as with other areas, tends to accumulate more rapidly after you get beyond some of the fundamentals. Finally, remember that you are not in training to become a programmer or a technical expert; you only need to know enough to understand how the microcomputer can help you in your current career. This chapter will provide a description of the components that typically make up a microcomputer system. These components include both hardware (the physical equipment that makes up a computer system) and software (the instructions to the computer which are loaded into the main memory of the computer on a temporary basis).

The microcomputer can be distinguished technically from other computers by the fact that its major electronic device is located on one chip rather than on several chips. A chip is a collection of miniature electronic switches that have been sealed in a silicon wafer. Neither the size, price, nor capabilities are such that these items will, in every case, differentiate the microcomputer from the mini-computer and even the mainframe computer. Mini-computers and mainframe computers will usually allow a large number of people to store information and to use the computer at the same time.

Most microcomputers are used by only one person at a time, but there are microcomputers which handle large amounts of information and are used simultaneously by many people. With increasing miniaturization, even those minimal distinctions which now exist between microcomputers and the so-called "larger" computers will diminish.

The major hardware components of a microcomputer system include the following: (1) a system unit which contains the main memory, the secondary memory and the processor, (2) the display, (3) the keyboard, (4) the printer, and (5) the communication devices. This grouping of equipment is what you would find in a typical microcomputer system. Although it is possible to use a microcomputer without all of these components, such a limited system is not very practical for most organizational applications. Examples of systems that can be used effectively without printers or communications devices include home computer systems and those used for certain instructional applications (e.g., learning how to program). The discussion which follows illustrates some of the reasons for the existence of each of the microcomputer components that are likely to be included in a professional workstation.

The System Unit

The system unit is typically a rectangular shaped container that is used to house the main memory, the secondary memory, and the processor. As a result, the functions performed by each of these internal components are occasionally attributed to the system unit.

The Main Memory

The main memory is composed of the electronic equivalent of miniature on/off switches which record information in a coded form. Each memory switch (called a bit) can be either off or on. In microcomputers, these switches are usually grouped in units of eight. The various possible combinations of "offs" and "ons" in a unit of eight form the codes which represent letters of the alphabet and numbers or symbols such as those on a regular typewriter keyboard. This concept of information storage is actually very simple. The revolutionary parts of this technology are its small size and great speed. Without miniaturization, this method of storing information would use acres of space filled with switch type devices.

In order for a microcomputer to be useful for organizational tasks, it should have a minimum memory space of 64,000 bytes. A byte is a unit of memory space and will store the code for one character, letter, or number. The byte is composed of 8 of the switch-like bits mentioned earlier. Another way of describing the storage capacity of a 64,000 byte microcomputer would be to say that it has 64K or

64KB of memory. The K is substituted for 1000 and the B stands for bytes. Information stored in the main memory is not permanent since it can only be stored while the computer is turned on. Once the computer is shut off, the contents of the main memory are lost. To compensate for this, some form of secondary memory (such as tapes or diskettes) is used to store information more permanently.

Secondary Memory

Both disks and magnetic tape are used for long-term storage of information that is obtained from the computer's main memory. This type of storage is refered to as secondary memory since it takes more time to store or retrieve information than from the main memory. The disk is the most common method of secondary storage used in microcomputers. This is a 5 1/4 inch diameter piece of plastic film enclosed in a square protective envelope. The microcomputer disk is a smaller version of the 8 inch flexible disk (or floppy disk) that is often used on larger computers. Information is recorded on the disk in almost the same way cassette tapes record musical sounds and voices. Electro-magnetic impulses change the pattern of the metallic elements that are bonded to the plastic. The computer parts that transmit the contents of the disk to the main memory recognize particular patterns on the disk which correspond to the way information is stored (by bits and bytes) in the main memory.

A computer disk drive that works somewhat like a phonograph turntable is used to record on and play back information from the disk. This device spins the disk beneath a magnetic head similar to those found on tape recorders. The disk drive is controlled by the processor or some similar microelectronic device. The processor tells the magnetic head where to record information as the disk passes under the head and where to obtain information once it has been recorded on the disk. A microcomputer disk will hold between 80,000 and 800,000 bytes of information, the equivalent of about 40 to 400 typed, double-spaced pages. These disks can be removed from the disk drive and stored for use at a future time. The disks can also be used as back-up information storage while operating the computer in case something unexpected occurs (such as a power failure) that causes the computer to erase the contents of the main memory.

The capacity of microcomputer disks is growing at a phenomenal rate. Several companies have recently begun to market disk drives that store up to 10 million bytes on a non-removeable 5 1/4 inch disk which uses the same space in the microcomputer system unit that is now used by the removeable disk. Ten million bytes of information is the equivalent of 4800 typed, double spaced pages.

Cassette tapes can also be used to store information from the main memory of a microcomputer. While they may be useful as backup, cassette tapes are slow and cumbersome to use in comparison to disks. As disks become cheaper, cassette tapes will be used less and less as a secondary storage medium. Computer cassette tapes can be recorded and played back using ordinary tape players but are often unreliable and can result in the loss of data.

Processor

The processor or microprocessor is the "intelligence" of the computer. It manipulates the data stored in the computer memory. This involves the storing, altering and retrieving of the information that is contained in the computer memory. Arithmetic operations such as summing columns of figures can also be performed by the processor. The processor in most microcomputers is about the size of a domino. A microprocessor of this size has the power of a computer which filled an entire room twenty five years ago. Some processors are able to multiply two 4 digit numbers in only a few thousandths of a second.

Display Device

The television screen is the most common display device used with microcomputers. It is known in the trade as a C.R.T. or cathode ray tube, the technical term for a television picture tube. If you look very closely at the tiny dots in a newspaper photograph, you will see an example of the same graphic display principle which allows letters and numbers to be displayed on a T.V. screen.

The television screen (C.R.T.) has thousands of tiny locations, each of which can be left dark or made to glow. Electronic circuits check each byte (space) in memory to see what character code (letter or number) is stored there. These circuits then cause the tiny locations on the screen to glow in order to display the characters that are found. A part of the computer memory is reserved for translating the character codes into lighted dots on the T.V. screen. For every character code used by a particular computer, there is a pattern stored that tells the circuits which dots on the screen to light for displaying that single character. This may seem rather time consuming but is performed at a speed which approaches that of light. It takes only a few hundredths of a second for the processor to check each memory space for a character code, then check to see what part of the screen to light up, and then light up the screen with the appropriate letter or number.

The much touted color capabilities of some C.R.T.'s does not always have great significance in an organizational environment since charts and graphs can be represented on black and white screens in quite readable fashion. In

addition, monochrome screens generally are more comfortable for sustained viewing. While it is true that the color coding on some types of graphic displays can be of assistance in understanding very complex information, the availability of color graphics often turns out to require a trade-off for some more practical aspect of microcomputer capacity (e.g., additional memory space). And since eight percent of the males in our society are color blind, there will be some people in just about every organization who cannot see the distinctions that are made on a color screen.

Keyboard

The keyboard is a device that is used to enter information directly into the main memory of the computer in the form of letters, numbers, and other characters. A microcomputer keyboard usually has all of the upper and lower case letters, numbers and symbols that are found on an electric typewriter keyboard and typically also contains a separate ten key numeric key area. From five to twenty additional keys are also included that can be programmed by various types of software to perform specific tasks. Many microcomputers are now available with keyboards that are detachable from the system unit. This allows the operator to individualize the position of the keyboard from time to time for greater comfort and ease of operation.

Printer

The printer most often used with microcomputers is called a dot-matrix printer. It has much in common with the technique used by a C.R.T. to display letters and numbers on a screen. In the printer, a vertical row of wire-sized pins (usually 9) about the height of a single typewriter letter is mounted in a tiny box. The box moves from left to right on a smooth, round bar. This box is about the size of the type element on an IBM Selectric Typewriter and, although it operates differently, serves the same purpose. As this box passes each potential letter space on the paper, the pins are poked against an inked ribbon to form a character pattern in dots on the paper in much the same way that the T.V. display will light up the dots on a screen.

This type of printer can produce very readable print, but it does not look the same as a typewriter's print. Therefore, it is not considered by most people to be of letter quality. However, as the dots become smaller and are printed closer together, these dot-matrix printer will become capable of more typewriter-like printing. This is similar to the difference between the printing of a slick color magazine photograph and the printing of a daily newspaper photo. The latter is coarser in appearance but legible nonetheless. The speed of small dot-matrix printers ranges from 40 to 200 characters per second. At a speed of 60 characters per

second, a printer would print a whole line of characters every second on an eight and one half inch wide sheet of paper. By way of comparison, someone who can type at the rate of 150 words per minute would only be typing at a speed of approximately 14 characters per second.

It is also possible to link a microcomputer to a printer which produces letter quality printing. Although they are a bit more expensive and somewhat slower, some offices use a printer which has a type element that is called a daisy-wheel. This type element serves the same function as the Selectric Typewriter ball, but is a flat circle with tiny petals which each contain the shape of a letter or symbol. These petals are hammered against an inked ribbon and paper much the same as the Selectric ball. Though they are much faster than ordinary typewriters, the daisywheel printers produce print which cannot be distinguished from that of a typewriter. Speeds of daisywheel printers range from 13 to 55 characters per second.

Communications Devices

Communications devices are used by microcomputers to connect with telephone lines and other communications media. The modem is the communications device that is used most frequently with microcomputers. Modems encode computer signals for transmission over telephone lines and decode the telephone line signals into a form which a computer will recognize at the other end. Several companies make a modem which connects directly to a modular telephone plug and bypasses the telephone itself. However, the most frequently used type of modem is the acoustic coupler which has two rubber cups that permit connection to a standard telephone handset.

Modems are often used to enable a microcomputer to serve as a terminal to some much larger computer system. For example, a connection can be made with the mainframe computer of an agency in order to obtain certain financial data. The data would subsequently be used on the microcomputer for planning, discussion and the development of fiscal projections that can then be reentered into the mainframe computer data base. This arrangement allows personnel to use a comparatively inexpensive microcomputer for many tasks while dialing up the larger system only when the size of a job or the time required is too great for the microcomputer.

Another form of communications device enables multiple microcomputers to communicate among themselves, share printers and large disk drives and even, in some cases, share each other's main memory space. This type of device can be as simple as a switch which can be turned to allow one of several computers to use the same printer. A more sophisticated communications device of this type is known as a network controller. There are many types of network

controllers available. Controllers are available that allow as many as 255 microcomputers to share disk storage space, printers and to communicate with each other. While this will probably be the dominant form of computer set-up within a few years, networking with microcomputers is in an early stage of commercial marketing and requires a great deal of caution on the part of the potential purchaser. With effective networks of considerable size and fast disk drives that contain large storage capacities, there will be little difference between microcomputing, minicomputing and mainframe computing.

Software

The term software has gained a certain currency in many fields, but has its own meaning in computer technology. It is simply the instructions to the computer to perform various tasks on the data that is given to it by the user. Though the computer can do many things, it must be given explicit instructions regarding what to do, when to do it, and what data to use. A characteristic of computer software is that it can be copied into the computer's main memory when it is needed to run a particular program. It is soft or volatile in the sense that the software does not remain stored in the main memory when the computer is turned off. The original copy of the software is usually kept in some secondary storage form (disks or tapes) and copied or loaded into the computer's main memory whenever it is needed.

The instructions that comprise the software are grouped into programs. A program is usually a group of instructions which are used for a specific purpose in a particular computer. A person who devises instructions for a computer is often called a programmer.

A microcomputer can usually be purchased with a great deal of software which is ready to use. The software is most often stored on a disk and is placed in the disk drive to load the software into the main memory of the computer. All software should have a written set of directions for the computer user, usually referred to as documentation. This may seem like a simple requirement, but many companies have very limited and perfunctory written directions on how to use their software. The comprehensiveness of the written documentation is an important factor by which to judge the practical value and usefulness of a particular piece of software.

In addition to good written documentation, some software will also include a C.R.T. display of appropriate instructions on how to use the software. This information should be available on the screen at that point in time when help in using the program is required. In some cases, this C.R.T. display is always present at the top of the screen unless turned off, and in other cases the user must press a help key when information is needed on how to operate the

program. Regardless of the approach used, all software documentation should be designed so that the consumer finds it easy to use.

Even though you have finished reading this description of the component parts of a microcomputer system, the topic may remain somewhat confusing. For those of you who would like a quick guide to the information that has been covered in this chapter, we have also included a glossary of microcomputer terms in Appendix A.

CHAPTER IV

DEFINING COMPUTER AWARENESS

Before describing the microcomputer awareness training that was carried out for state education agency personnel, it is important for the reader to understand the major factors that were used in structuring the topics and instructional processes used in the training. These factors emerged from a consideration of the following questions: (1) how should computer awareness be defined? (2) what specific needs do the learners have in relation to the topic of computer awareness? and (3) what needs does the organization have in relation to the topic of computer awareness? These questions are the focus for Chapters IV, V,and VI.

There is a considerable amount of debate about the meaning of the term computer awareness. It is unlikely that this debate will diminish in the near future because the term takes on variations in meaning when applied to different groups of people. As a result, it is important to keep in mind that computer awareness will always need to be defined according to the specific context in which people are operating. For example, people doing fiscal recordkeeping will need to know more about fiscal recordkeeping software than about computer assisted instruction software if they are to be considered aware of computers in their area of specialization. This is not to suggest an unnecessarily narrow focus but rather to make the training experiences relevant to a particular career context. There may be personnel who do both fiscal and program monitoring and need to know something about both of these subjects.

While it can be useful to give an operator of a computer some insight into machine processes by demonstrating certain elementary programming principles, the notion that computer awareness must always include the teaching of a computer programming language is both inappropriate and an unnecessary use of an organization's limited training resources. If the ultimate purpose of awareness training is the integration of computers into an existing work environment, instruction should be based upon how the computer will be used by those who are being trained. In most cases, the best approach will be to focus the training on existing off-the-shelf software of the type that eventually will be used in the participant's work environment.

Emphasis on learning how to program goes back to the time when this skill was a prerequisite for using a computer. Since many of the people who now serve as trainers received their first exposure to computers in programming courses, it may seem to them like a natural and appropriate approach to use in familiarizing others with the functions of a computer. But times have changed, and it is now possible to use a

microcomputer for a wide variety of tasks without ever understanding anything about programming.

In certain cases, it will be important to teach programming skills. For example, if a group of state education agency personnel are going to provide training for school teachers on how to use programming skills in the classrooms, knowledge of those programming skills must be acquired by the instructors prior to carrying out their responsibilities. However, since the acquisition of programming skills requires a level of participant involvement and a time commitment far beyond that available for awareness training, it is best to develop those programming skills as a separate training activity.

By focusing the training on specific environmental and learner needs, we may have settled certain aspects of the controversy over a definition of computer awareness. However, there are still varying opinions regarding the specific concepts and processes which should be used in developing awareness training programs for adult populations.

Awareness training for adults is usually structured as an introductory program where information about a given topic is communicated in one direction - from the instructor to the learner. The implicit assumption is that the acquisition of knowledge by the learner will create a greater awareness of the topic and furthermore, that this greater awareness will eventually lead to further exploration and learning by the trainee. This type of adult awareness training occurs most frequently in the form of conferences where speakers give lectures about a particular segment of knowledge to a large and, for the most part, passive audience.

In order for this approach to be effective, certain conditions are necessary. First, the audience needs to have a minimum level of familiarity with the terminology that is being used by the speaker in order to comprehend the new information that is being provided. Audience motivation and attitude are equally important; the participants not only need to be interested in the topic, they must also believe that they can assimilate this new information into their existing knowledge base. Finally, the audience must have a clear sense of the next steps that they will need to take in order to convert their new knowledge into something that is professionally or personally useful.

When such a traditional conference format is used in the structure of computer awareness training, it is usually not very effective. Participants are often confused by the terminology and worried about how the computer will change their jobs. They also may be convinced that technical experts are the only people who can learn to use computers. Conference participants often do not understand how to integrate information about the computer into their own base

of experience and have difficulty identifying with instructors whose computer career paths seem so alien.

Providing information about computers is a necessary part of awareness training; however, it is even more important to respond to participant fears and concerns and, in addition, to provide the trainees with an opportunity to use the equipment. This type of multiple emphasis is necessary because computer awareness is largely a matter of affective learning, although there are cognitive and human-machine interaction elements that also need to be addressed.

At a minimum, awareness involves the attainment of a certain degree of comfort with and a lack of reservation regarding the subject matter. Increasing adult awareness about computers should also help to diminish any anxieties they might have about computer technology. In those cases where training is sponsored by an organization for its employees, computer awareness implies the development of a positive attitude among participants (or at the very least, a degree of neutrality) toward the application of this technology in their work or professional activities.

Our definition of awareness also includes the notion that some cognitive behavior is involved since the learners must know something about the topic. Knowing something about computers is a part of becoming aware of them, and becoming aware of computers is an important step toward being able to use them. Just how much the learner needs to know in order for a state of awareness to have been achieved remains an unsettled issue and probably varies considerably both within and among groups of learners. We have found that an effective approach is to provide enough information so that participants can begin to use appropriate terminology in describing the equipment that they are using in the training session. This seems to work best when the information is provided both verbally and in a written, quick reference format.

Finally, our definition of awareness includes the need for some actual experience with the equipment. This phase is a part of the computer awareness process in much the same way that getting wet is a prerequisite for learning to swim; people are simply not going to learn as much if they just talk about using computers. Many adult learners are initially reluctant to use the computer, primarily because they are worried about breaking it or somewhat uneasy about demonstrating their lack of skill in front of colleagues. This concern can be overcome by structuring simple routines that demonstrate how the computer can manipulate information of the type that is used in the participant's professional role. When implementing this phase of the training, it is important that participants have a written checklist of steps to follow as well as someone to call on for help.

Thus, our definition of computer awareness focusses training on a particular career context and combines affective, cognitive, and hands-on learning experiences. It is a definition which can be used with groups of learners who not only lack knowledge of computers but also may be somewhat disinclined (either rationally or irrationally) toward using them. In an adult learning context, awareness is a logical first step toward the development of greater responsiveness on the part of the learner. This greater responsiveness will subsequently generate an increased receptivity to the direct use of microcomputers in the workplace.

In addition to knowing how we have defined computer awareness, it is also important for the reader to understand how we approached the task of responding to the adult education needs of the state education agency personnel who participated in the programs. That discussion will take place in the next chapter.

CHAPTER V

THE NEEDS OF ADULT LEARNERS

State education agency professionals are, first and foremost, adult learners. Adult learners approach any learning situation in a manner that is different from that of a child. Although this may seem like a simple enough assertion, it is surprising how often it is disregarded in planning or carrying out much of the training that is provided for adults. Consideration of adult learning needs is especially important when the training covers a technology that many people view with some uneasiness. This discussion of adult learning needs has been organized into the following three categories: (1) difficulties associated with redirecting the learner's career orientation; (2) problems caused by the learner's isolation and alienation from the topic; and (3) conditions that are necessary for effective adult learning to take place.

Career Orientation and Redirection

Most of the adults in public sector organizations have been in the world of work long enough to have developed a sense of personal career orientation. As with any career experienced adult, members of this group have had time to apply their own training and education on a day-to-day basis. They are likely to have become quite fluent in this daily application of their talent and will have developed confidence that they have mastered the skills that are needed for their jobs. Many of them will have thought about their career goals and will have developed certain expectations about their future in the organization.

While our society usually places a high value on people who have considerable career experience, this experience does not always transfer easily into the revolutionary world of microcomputer technology. Those who seem to adapt most readily to microcomputers are children, in part because they are not burdened with a wealth of experience that must be restructured. For many non-technical professionals, microcomputers are viewed as an intrusion that may compromise their carefully nurtured career plans. At the very least, the introduction of microcomputers will be disruptive to their typical patterns of workplace activity.

All personnel will not find the process of adjusting to the use of microcomputers equally difficult. Those staff members who previously have been successful in making major career changes will often find that this experience can ease their adjustment to the use of microcomputers. The reason for this is that career shifts usually require that people identify transferable skills and subsequently go through the process of adapting those skills to new work environments.

Another example of personnel with an advantage are those whose job responsibilities require their simultaneous involvement in several specialized territories. Experience in translating information among diverse groups of specialists can ease some of the communication difficulties that a non-technical person faces when learning from computer experts.

The successful use of microcomputers in any organization depends on the trainees' ability to transfer what they have learned in a training session back into their work environment. The transferability of learning is greatly enhanced when trainees are able to apply their new knowledge to real world problems and tasks for which they are responsible. Adult learners also need to understand how the microcomputer can be used to enhance their career opportunities both within and outside the organization. Well designed programs and carefully selected instructors can be quite helpful in responding to these legitimate staff concerns.

Isolation And Alienation From Computer Technology

Historically, the computer has been a tool used to perform specialized functions in an isolated subunit of the organization. In the past, people who used computers were often trained differently and pursued their careers in a pattern that was somewhat dissimilar from the one followed by non-technical professionals. For both of these groups, it was very easy to become blocked into a specific career path with a consequent feeling of alienation about the work of the other group.

A hallmark of our modern, industrial society is the complex division of labor and high degree of specialization within organizations. This specialization has led to a situation where people know only a very small fraction of all of the information or technology in a given career area. When members of our culture are faced with areas of specialization that fall outside of their own career or vocational experience, they can become quite comfortable deferring to experts. This process of deferring to the specialist has become rather prominent in our culture at this time. Complexity has bred specialization and specialization has resulted in a compartmentalization of knowledge. Within this societal context, it is quite natural for non-technical professionals in public agencies to defer to the expertise of others in areas of technical knowledge.

Coupled with this almost reflexive deference to expertise in our culture is the concentration of power in the hands of those people who are experts. If someone's segment of the vast information pie is of great significance to a large percentage of the population, then many people are obligated to that expert in some way. With the relatively low level of scientific literacy in our society as a whole, the expert

power of the scientific community is more heavily concentrated relative to those who are less literate in science and technology. The level of scientific and technological literacy is far lower in our culture than would be imagined for our level of technological development. The 1982 report of the President's Committee on Science and Engineering Education suggests that Americans have a dangerously low level of science literacy for the national interest.

This low science literacy level only serves to heighten and emphasize the deference to experts in science. Deference to experts is not entirely without merit, and there are many situations where it is essential. However, deference does lead to polarization and distance in that those who defer to others do not necessarily feel a sense of identification with the experts. The field of computer technology originally contained only experts since engineers and other science-related professionals were the only ones who used computers. As a result of the microcomputer revolution, the resources of the computer are now being placed at the disposal of less science-oriented members of our population. The historical role of the computer expert may serve as a barrier to computer usage by non-technical personnel. Since this non-technical population tends to undervalue its ability to understand anything mechanical or technical, it is possible that deference to the experts may prevent appropriate use of the technology.

Due to the original use of computers by professionals in the mathematical sciences, many adults associate the computer very closely with mathematics. Math departments in high schools and colleges continue to emphasize the acquisition of computer skills and this has created a misimpression regarding the types of skills that people must have in order to utilize computers. The computer has been shrouded in mystery for the average lay-person in our culture for the last 30 years and is often associated with science, mathematics, and engineering.

Non-technical professionals frequently lack a sense of ease with mathematical and scientific concepts and in some cases there is even a phobic kind of feeling about mathematics in general. One of the underpinnings of effective computer demystification is an understanding that knowledge of and comfort with mathematics is not an essential prerequisite for use of the computer.

Unlike previous systems which could only be operated by specialists, the microcomputer can be used by someone who knows little or nothing about the inner workings of the machine. With the development of more and more sophisticated information processing capabilities, the microcomputer has extended the reach of the average user over a broader area of knowledge. For example, use of a microcomputer that is connected by telephone to a legal information service can

both simplify and enhance the effectiveness of a search for special education litigation.

While most people associate only mathematical skills with the computer, there are other skills which are congruent with the demands of even the most sophisticated computer uses. For the most part, these skills fall within those disciplines which require that an individual think and work in some form of notation that is different from their native, natural language. Computer languages have vocabularies and syntactical rules which, while narrower than most natural languages, do have much in common with the processes used in speaking a foreign language or expressing oneself in musical notation.

Separating the computer from its scientific origins and identification is important and can be accomplished in part by placing microcomputers in locations that are both convenient and easily accessible to non-technical personnel. In addition to physically relocating the equipment within the general work environment, it is also important that the microcomputer function in such a way that it clearly demonstrates its usefulness to the non-technical personnel who will be using it.

Demystification essentially means placing the technology in a context that allows the learners to imagine a microcomputer sitting on their own desk in the same manner as a telephone, typewriter, calculator, or dictating machine. In setting up a training program, it is helpful to structure an environment that looks and feels more like the participant's work environment than like a computer laboratory.

Conditions Needed For Effective Adult Learning

Computer training for adults who have been actively pursuing their careers for many years places special requirements on those who would provide it. Adults who have developed career and role behaviors over a considerable period of time can learn more effectively if certain conventional instructional techniques are modified. For example, large group lectures where the speaker's approach is to provide one-way communication of information to a passive audience will not be very effective for those adults who are confused by the terminology or afraid of the new technology. Some people may even use such inappropriate training techniques as their rationalization for ignoring the current high technology revolution.

In the process of becoming adults most people acquire strong preferences for certain patterns in their lives. Examples include their work schedules, how they like to be treated by others, when they have their coffee breaks, what kinds of chairs they like to sit in, and their preferred approach to learning new information. When training is held

in uncomfortable physical surroundings or structured in such a way that the participant's routines are disrupted in major ways, this can result in a compromise of the learning that might otherwise take place.

The instructors who are used in awareness training should be oriented toward non-technical learners. This means that the instructor is responsible for providing information about microcomputers in language that participants understand. This approach is especially important when the trainees know nothing about computers and have always avoided math and technology.

Instructors should be able to help participants understand how to transfer their skills from one territory to another and move beyond current perceptions of career specialization. It also helps if trainees can identify with their instructor either through a shared area of specialization or because the instructor has overcome some of the same learning difficulties that are now being faced by the participants. For example, an instructor with previous experience in both occupational and special education who acquired his knowledge about microcomputers through personal experience will probably be quite effective in working with educators.

Training materials should be developed specifically for the particular role that groups of trainees have within their agency. By using the word processing capabilities of the microcomputer and knowledge of the learner's work environment, the trainer can incorporate specific examples of participant roles directly into training materials. Under such an arrangement, the training materials that are used for managers would be different from those that are used for staff who provide instructional support activities for schools. In those cases where instructors lack experience with a specific group, they should spend time with some of the participants prior to the training or serve initially as part of an instructional team that includes other trainers who are familiar with the work responsibilities of the participants.

Wherever possible, instructional activities should be structured in such a way that they clearly demonstrate how participants will be able to perform their jobs more efficiently and effectively by using microcomputers. This can be easily accomplished for many of the administrative tasks in an organization by using an electronic spreadsheet, graphics program, or some type of data base management software. For example, in a training activity participants would be asked to carry out a specific task using a hand calculator and then provided with a demonstration of the speed with which the same task can be accomplished by a microcomputer. Another example would be to use the powerful graphics capabilities of a microcomputer as a means for developing the overheads and other visual displays used in

the training lectures. Staff members who use visual displays and graphics in their work will be able to quickly grasp the significance of such a capability.

Training activities should be based on some form of preassessment that provides information on the existing levels of knowledge and skills posessed by the learners. Although much of this information can be gathered ahead of time, it is also useful to solicit feedback from the participants during the actual training regarding components such as the level of difficulty of the instructional materials, the pacing of the training events, and the effectiveness of the instructors. Systematic evaluation of all aspects of the training can be very helpful in refining future programs.

It also helps to have top administrators encourage the use of microcomputers since this indicates an organizational committment that staff members cannot ignore. Such encouragement is even more effective where the executives within an agency also demonstrate their own professional interest in microcomputers through personal use.

If adult training is to be effective, it must be directed by the learner. We have found that the best way to respond to adult learning needs is to directly involve a representative selection of participants in all planning, implementation and evaluation activities. We have also found that it is helpful to continually focus our attention on the issue of how we can help participants transfer their learning back into the work setting. When carried out properly, this approach results in training that functions as an effective support system for self-directed staff members who have accepted responsibility for their own personal growth.

At the same time, since the training programs that we are concerned with are supported by organizational resources as a means for improving the efficiency and effectiveness of the agency, it is also critical to mesh this emphasis on self-directed learning with an understanding of the organization's needs. This will be the topic that is covered in Chapter VI.

CHAPTER VI

THE NEEDS OF THE ORGANIZATION

In defining computer awareness we stressed the need to focus training on how a computer might be used in a specific career or organizational context. Since state educational agency personnel were the focus for this training, we also looked at how the ability to understand and use microcomputers was important within the context of the state education agency. We found that employees have two different categories of needs relevant to the knowledge and use of microcomputers. These two categories include: (1) the knowledge and skill needed to provide technical assistance to local school systems and (2) the knowledge and skill needed to carry out the organizations own internal administrative processes.

Technical Assistance Needs

The widespread applicability of microcomputer technology in public education suggests that one aspect of this computer awareness training should focus on how microcomputers are being used in the state's public school curricula. There are essentially five roles for microcomputers in public education. These include: (1) career education related to operation and programming of computers; (2) development of logical thinking and programming; (3) simulations of processes not normally observable in a classroom setting; (4) art, music and design; and (5) reinforcement of certain factual information which lends itself to drill and practice activities. Each of these public education roles will be described briefly.

The growth of the high technology industries, particularly in Massachusetts, places very specific demands on the public schools to prepare students for those types of careers. High technology is one of the few areas in the economy which is currently showing signs of growth. Varied career paths exist within the high technology cluster ranging from electronics assembler through systems programmer. In order to carry out the responsibilities associated with their roles, state education agency personnel need to be aware of how public schools might apply computers in these types of career education.

An increasing number of schools are using the computer to teach logical thinking and programming. The process of expressing onself in a computer language is thought by some educators to help students learn how to solve problems in a sequential and logical fashion. In this area of teaching, students without a specific career interest in high technology would use computers to develop logical thinking abilities.

In many of the physical and biological sciences, there are phenomena about which students must learn but which are difficult to observe in a classroom. For example, the decay of an enzyme can be simulated with color graphics on a microcomputer system. This allows the input of different conditions to test varying outcomes with easily identifiable graphic results.

In art, music and design, use of the microcomputer has been expanding rapidly. The graphics capabilities of microcomputers are being used to provide a new medium for expressive statements made by the artist. Electronic music has been used by musicians for some time. The inexpensive microcomputer can generate quite a range of sounds and is now used for teaching music theory and composition. With the possibility of creating designs on a screen which can be interpreted on paper by a printer or plotter, teachers in the visual arts have also become more interested in the use of microcomputers in the classroom.

For those aspects of the educational process which require drill and practice, the microcomputer can be programmed to present students with questions for practice. In addition, a wide variety of commercially available software has become available that emphasizes the use of drill and practice. Increasingly public school teachers and administrators have been seeking information and assistance from state agency personnel regarding this type of instructional material.

Administrative Needs

The economic imperative for the state education agency also suggests the need for an awareness of certain administrative tasks that can be performed by the microcomputer. Administrators must learn how microcomputers can be used in the management of a state education agency. This awareness training component is based upon the need to maintain a certain level of professional and support services in the face of reductions in both personnel and funding. As the size of support staff has decreased there has been a need to improve the productivity of the remaining support staff. The administrative tasks fall into the following two areas: (1) learning to coordinate the use of technology by subordinates, and (2) learning to directly use the technology for managerial applications.

Administrators need to develop a greater awareness of how to manage the use of microcomputer technology by both support staff and professional personnel in their organizations. Personnel in the state education agency have not had very much experience in the use of word processing, electronic spreadsheets, the creation of electronic files, or any of the other functions that are made possible through the use of microcomputer technology. A rather unique dimension to

this managing process will include the use of keyboard devices by both support staff and professional personnel.

Management functions associated with the introduction of microcomputer technology include the following: (1) selection, installation and service of equipment; (2) identification of appropriate software; (3) staff training; (4) prioritization of microcomputer task assignments during the transition period; (5) standardization of information storage and dissemination formats; (6) creating easy access to information stored in mainframe computers; (7) developing appropriate electronic communication options with local educational agencies; and (8) maintaining equipment and software compatibility as the use of microcomputers expands within the agency. In order for managers to function effectively in the future, they will need to acquire sufficient information about microcomputer technology to be able to make informed decisions about these and other management issues.

Another unique dimension of this technology for managers will be their own use of microcomputer workstations for certain management tasks. While managers seldom have felt comfortable using the keyboard, the information power of the desktop microcomputer has been so impressive to many managers that they have ignored their traditional reservations. This can be seen most vividly in planning situations where managers have begun to work with budget projections on the screen of a microcomputer. The ability to get five or six versions of a budget from a microcomputer in half an hour has made it an invaluable tool for many managers.

In summary, the microcomputer training needs of the state education agency include provisions for technical assistance (i.e., related to instructional activities that occur in schools) and also administrative processes (i.e., related to the operation of the agency). Since the state agency personnel who participated in our microcomputer awareness training programs had a mixture of both types of responsibilities, our training had to be responsive to both areas of organizational need. In the next chapter, we will describe the methods and activities used in the awareness training sessions that were conducted by the Institute.

CHAPTER VII

AWARENESS TRAINING PROGRAMS

This chapter begins with an overview of the computer awareness training programs that were conducted for the Massachusetts Department of Education during 1982. This introductory section is then followed by a more detailed description of each program.

Overview of Training Programs

Beginning in July 1981, the Institute conducted a series of training needs assessment among state education agency personnel that indicated a general staff interest in computers and data processing. In response to this staff interest we designed a one day computer awareness program that was implemented in five different locations during February and March of 1982. These initial one day programs were well received and helped to create a demand for additional training. Since then, the Institute has conducted over 45 days of microcomputer awareness training for state agency personnel along with five days of specific skill training in the use of SPSS (Statistical Package for the Social Sciences). We have learned much from both the trainees and the instructors in the process of designing, implementing and evaluating all of these programs and continue to discover ways to improve the effectiveness of the training.

The training was funded alternately by the Divisions of Occupational and Special Education. Planning team members in each office met with Institute staff to discuss the specifics of workshop content and registration procedures. Training catalogs describing the program options were distributed to occupational and special education staff members. Presentations describing the training programs were also made in each of the offices. These presentations emphasized the irrelevance of mathematics for the average computer user and the need for non-technical personnel to become aware of computers.

Registration for most of the programs was closed almost immediately because of the demand and there were often waiting lists equal to the size of each class registered for the programs. Although participation in the training was entirely voluntary, there was a general organizational climate which encouraged staff development and supported those staff members who were interested in taking advantage of the computer awareness programs. Registration was on a "first come" - "first served" basis; however, some difficulty

arose in determining the priority of requests when the registration lists filled up rapidly. In those cases where programs were oversubscribed, participants were selected by management personnel from among those who had expressed an interest in attending.

Certain programs were offered only to personnel who occupied specific positions within the organizational hierarchy while other programs included personnel from several levels within the organization. Some of the programs focussed exclusively on administrative or instructional applications for microcomputers while other programs included a dual emphasis on both of these areas.

The programs were diverse in structure and format since we were interested in evaluating the effectiveness of a variety of different approaches. Group size varied from four to thirty participants. The time allocated to various groups of trainees ranged from 1 1/2 through fifty instructional hours. In those cases where instructional time extended beyond six hours, we used several approaches including a series of one day training sessions scheduled over several weeks and a one week residential arrangement.

We conducted the programs in a variety of different settings both within and separated from the working environment of the learners. There were some explicit geographic factors in the site selection process that were necessary to make the training accessible to the widest range of personnel. For the most part, training sessions were conducted in both the eastern and western regions of the state.

Equipment factors became a dominant concern in site selection. Given our operational definition of microcomputer awareness, there were certain types and quantities of equipment that were essential to the use of any given training site. While it was usually possible to arrange for the use of a site with microcomputers, we often had to bring additional microcomputers to a training site in order to accomplish the instructional objectives. The physical environment within which the training took place was another important factor in site selection. Examples of elements that were taken into consideration included well lighted and adequately ventilated learning spaces with a sufficient number of tables and comfortable chairs.

Instructional personnel were selected on the basis of their technical knowledge about computers, their awareness of the functions performed by personnel in the agency, and their skill as instructors. Several instructors used a lecture and discussion format without equipment present, others used microcomputer equipment for demonstration purposes only, and some of the programs were designed so that the participants were using microcomputers as much as 75% of the time.

The types of equipment used included Apple II, TRS-80 Model III (Radio Shack), IBM Personal Computers, PET and CBM (Commodore), and terminals to the state college system computer. Since the Institute did not have sufficient microcomputer equipment for the training, it was necessary to borrow equipment and microcomputer laboratory facilities from various public and private agencies. As a result, our equipment options were often somewhat limited by conditions such as the number of units available, the software to be used with a particular group of learners, the convenience of the location, and our attempts to minimize costs.

Even under the best of circumstances the use of a new training site usually meant that we were faced with the task of adapting either the equipment or the software so that we could meet our instructional objectives. We also experienced some equipment failure with borrowed microcomputers during the course of the training programs. As a result, the instructor or someone on our staff needed to know enough about the various types of equipment and software so that they could complete any necessary adaptations prior to training as well as make minor equipment repairs during the program.

Initially the awareness training programs were quite diffuse in both topic and structure; more recently, programs have tended to focus specifically on work related tasks and functions performed by the learners. This change in focus is a result of several factors including an increase in our knowledge about effective training processes, greater sophistication of agency personnel (brought about in part by the awareness training), and the agency's decision to purchase microcomputers for administrative usage. Now that this decision has been made, much of the agency's training focus has been directed toward preparing staff for the arrival of the equipment.

Eight different types of awareness programs were conducted. Distinctions among these programs are often blurred because new programs evolved from unmet needs that were discovered in previous programs. The descriptions that we have used for each of these programs also differ somewhat, again reflecting changes in data gathering techniques that occured as new programs were developed. Based on what we have learned during the past year, we would probably modify these programs substantially if we were going to implement them today. Therefore it is inappropriate to use any of these program descriptions as inflexible models. At the same time, these descriptions are useful since they can provide the reader with an understanding of the various types of activities that we used in our efforts to increase computer awareness among trainees.

The training program titles that we used for the eight types of awareness programs are as follows:

(1) Computer Awareness
(2) Computer Awareness for Clerical Personnel
(3) Understanding Mainframes
(4) Microcomputer Literacy for Resource Persons
(5) Microcomputer Literacy I
(6) Microcomputer Literacy II
(7) Microcomputer Literacy III
(8) Administrative Applications for Microcomputers

The remainder of this chapter will provide a detailed description of each of these training programs.

1. COMPUTER AWARENESS

Instructor: Al Manson

Dates/Sites: 2/25/82 - Framingham Public Library
2/26/82 - Greater Boston Regional Center
3/08/82 - Plymouth Carver School, Plymouth
3/04/82 - Westfield State College
3/18/82 - UMass/Harbor Campus

Introduction to Topic

Computers...what they are...what they can do, etc. is of a common concern for most people. People are interested in learning about computers but are often confused or intimidated by technical language and their own lack of knowledge about how to ask questions. The purpose of the one-day workshop was to present an introduction to computer terminology, how a computer system works, and to discuss the implications of using computers for office work. The session was designed to provide participants with a basic working knowledge of computers so they would be better prepared for hands-on sessions in the future.

Needs Prompting Training

The original July needs assessment data showed that agency staff desired training related to data processing and computers. Project staff conducted a second assessment in January in order to collect information about more specific computer training needs. This second assessment showed that 80% of the responding staff wished training in "basic computer awareness." This workshop was designed to fill the "computer awareness need."

Training Objectives

1. Teach a basic vocabulary so as to communicate with data processing people.

2. Make one aware of what a computer is and is not.

3. Understand the role of the system analyst and the role of the participant in the development of a system.

4. Have an understanding of what is in the future in an office environment.

Training Format

This workshop used a lecture and discussion format. The instructor spent the first part of the morning introducing computer terminology and explaining the use of a computer to facilitate office record keeping. His lecture centered around an analogy of comparing record keeping in a store to various aspects of a computer system. During the later part of the morning the instructor used a slide tape presentation to illustrate various computer hardware components. The first part of the afternoon session consisted of a brief discussion of the inner workings of a central processing unit. Following this, the instructor discussed the concept of data base management and encouraged participants to suggest ways they could use similar systems. The last part of the afternoon varied from session to session; in some workshops the instructor discussed word processing and other office computer applications. In other sessions he encouraged participants to discuss educational applications. Handouts for this session were supplementary to the discussion.

Synopsis and Recommendations

Based on information that participants provided on the evaluation forms, these workshops were extremely well received. Participants were enthusiastic and nearly all wanted more training. This workshop series seemed to provide a sound basic knowledge for further training.

If this training were to be replicated participants suggested the following changes:

1. Have actual hardware available; perhaps substitute a quick on-site tour for the slides.

2. Use more examples related to specific agency tasks.

3. Include a brief overview of the current status of computers in the agency.

4. Include an overview of computer training options so participants can seek out their own training.

2. COMPUTER AWARENESS FOR CLERICAL PERSONNEL

Instructor: Nancy Croll

Dates/Sites: 6/24/82 - Radio Shack, Boston
8/17/82 - Radio Shack, Boston
9/15/82 - Radio Shack, Springfield

Introduction to Topic

As offices are modernized and word processing systems introduced, clerical staff will need to learn to work with these systems. The purpose of this workshop was to provide an introduction to computers and allow participants an opportunity to try out word processing and spreadsheet software. The approach emphasized hands-on experimentation.

Needs Prompting Training

The agency was beginning the process of acquiring word processing capabilities. Most clerical staff had heard rumors about this and were becoming concerned about how such equipment would affect their positions. In addition, as professional staff had been provided opportunities to participate in computer awareness training, clerical staff began to request similar training.

Clerical staff also have different needs than professional staff for specific training. These include: an understanding of how office configurations might be affected by word processing, the types of job titles and associated skills that will be needed as word processing is introduced to offices, and information about training options.

Training Objectives

1. Familiarize participants with computers: history and evolution.

2. Introduction to the word processing software package Scripsit.

3. Introduction to the spreadsheet software package, Visicalc.

4. Overview of computer related jobs: past, present, and future.

Training Format

The instructor alternated between lecture and hands-on experiences with the software packages. She began the morning with a brief overview of the history of computers leading up to current trends. The second part of the morning was spent on "Scripsit", a word processing program. The instructor began by having participants just practice typing. She described the keyboard and provided a handout to be placed on the microcomputer. She then talked participants through a series of exercises in which they practiced deleting and inserting words, lines, and paragraphs. The training coordinator assisted by circulating around the room and assisting participants as they ran into problems.

The afternoon session began with an overview of some of the more advanced procedures in word processing and a demonstration of formatting and printing options.

The second part of the afternoon covered Visicalc. The instructor prepared a simple spreadsheet example for participants to key into the microcomputer. The instructor showed participants how to use special commands to format the spreadsheet. Participants learned how to enter formulas and practiced setting up their own problems. The instructor and training coordinator discussed ways this type of program could be used with agency data.

The last part of the afternoon focused on specific jobs in the computer field. The instructor discussed job requirements, training options, and salary ranges.

Overall, the training format emphasized participation and discussion with some lecture. The instructor used specific handouts with instructions as well as writing everything on the board. Her exercises were structured so that participants who worked faster could move ahead at their own pace.

Synopsis and Recommendations

Responses on the program evaluation forms indicated that this was an excellent introductory workshop but definitely needs expanding. Participants indicated that a handout on elementary computer terminology would be helpful. Class size must be kept small with a maximum of two people per computer, preferably only one. It is also important to have an assistant who can circulate around to work with participants who have problems. The explicit instructions for Scripsit were excellent. A similar set for Visicalc would be helpful.

3. UNDERSTANDING MAINFRAMES

Instructors: Marilyn Santiesteban
Tom Collins

Dates/Sites: 3/5/82 - Department of Education, Park Square

Introduction To Topic

Mainframe computers are the large computers which have traditionally been used by organizations as the "heart" of their data processing systems. This half-day workshop provided a brief overview of what a mainframe computer is and how it is differentiated from microcomputers and mini-computers. The day also included a tour of the department's computer facility and information on how the agency currently uses its computer.

Needs Prompting Training

Needs assessment data showed that agency staff desired a variety of training experiences related to computers. Discussions with staff and planning team members revealed that many staff did not know much about the agency's current computer usage. This workshop was designed to familiarize staff with what was available and to answer questions. It was conceived of as a short term follow-up to the computer awareness training.

Training Objectives

1. To learn what a mainframe computer is and what it does.

2. To visit the department's computer facility.

3. To become aware of what information is kept on the department's computer.

Training Format

This three hour training session was divided in three parts. During the first hour and a half the instructor lectured on mainframe computers. She described what they are, how they work, and what they can do. During the second hour the instructor and participants toured the department's computer facilities. This tour was led by Tom Collins of the department. He pointed out various equipment and described the kinds of services his bureau provides. During the last half hour participants asked questions and discussed various issues related to what they had seen.

Synopsis And Recommendations

Generally the participants were pleased with this introduction to mainframe computers. This session would be easily replicable. It is probably a very appropriate training experience for staff and managers just to familiarize them with what is currently happening with computers in the department. This session emphasized information dissemination rather than skill acquisition. As the department's computer capabilities expand it might be appropriate to structure a session similar to this one and offer it as part of an orientation program for new staff. This type of session is also an excellent forum for staff to discuss and share among themselves their own data processing needs.

4. MICROCOMPUTER LITERACY FOR RESOURCE PERSONS

Instructor: Jan Braverman

Dates/Sites:
3/11/82 & 4/20/82 - Westfield State College
3/18/82 & 5/13/82 - Mass. Maritime Academy
3/25/82 & 4/29/82 - Fitchburg State College
4/13/82 - Sturbridge, MA (Special Education Conference)

Introduction To Topic

Increasingly schools are using microcomputers to facilitate their own administrative procedures and as teaching tools for students. Agency personnel are having to work with these schools and many staff feel a lack of knowledge about the use of microcomputers. The purpose of this workshop series was to introduce staff through hands-on experience to: (1) microcomputers as administrative and teaching tools, basic concepts of computer languages, and ways of evaluating hardware and software. The overall goal was to assist staff to become more aware of microcomputer terminology and to help them feel more comfortable in talking with school personnel who are currently using microcomputers or are planning to use them.

Training Objectives

Session 1:

1. How a computer language is used to store and retrieve information.

2. How a computer language is used to instruct a computer.

3. Microcomputer applications for instruction and administration.

4. Introduction to terminology in microcomputer sales literature.

Session 2:

1. Understanding the difference between the role of a computer user and computer programmer.

2. Understanding capabilities and major distinctions in storage, capacity, flexibility, and cost in microcomputers.

Session 3:

1. Understanding major potential problems associated with purchasing a microcomputer.

2. Understanding differences among writing, running, and storing a computer program.

3. Understanding how to locate three different types of resources about microcomputer hardware and software.

Training Format

General Overview:

This workshop was divided into three sessions each of which built upon information generated in the preceding session. The series was held at three different sites. Sessions 1 and 3 were held either at Fitchburg State College, Mass. Maritime Academy, or Westfield State College. Session 2 was a combined session including participants from all three sites and was held at Sturbridge in conjuction with a computer vendor demonstration run by the Institute for the Statewide Special Education Conference. The three different sites presented some problems because each site had a different mix of available microcomputers. Thus, although the session formats were basically the same, detailed instructions and programs varied with the brands of microcomputers.

Specific Sessions:

SESSION 1: This session was divided in three parts which mixed discussion and hands-on work on microcomputers. The first part of the morning involved administering a pre-test and a brief discussion of microcomputer hardware terminology. Much of this discussion and lecture occurred while participants sat at individual microcomputers.

The second part of the morning and the first part of the afternoon involved hands-on experience with very simple computer programs. The instructor provided participants with several programs each of which demonstrated the ability of a computer to store and retrieve information in a different way. The instructor began the hands-on session by instructing and showing participants how to turn on the machine, load, and run a program. After participants had practiced these basics, the instructor moved on to simple programs. Participants were given handouts that demonstrated the steps in running each program. The instructor would read through the handout for each program and then have participants run the program on their individual computers. The instructor circulated around the room and provided assistance as necessary.

The third part of the afternoon involved a discussion of microcomputer sales literature. Participants reviewed a sales catalog distributed by Radio Shack and discussed terminology. All participants were given a field assignment to visit a computer store and report back at the next session on their discussion with the salesperson.

SESSION 2: This session ran two and a half hours and focused on evaluating microcomputer hardware. Participants had access to a computer vendor demonstration if they wished to ask more questions of hardware salespeople. The session was divided into two parts. During the first part of the session participants reported on their field experience and discussed their findings and feelings about the various machines. During the second part of the session the instructor used a hardware evaluation form to lead a discussion comparing the merits of various microcomputers. At the end of the session participants were able to choose further reading material from a variety of microcomputer sales information.

SESSION 3: During this session participants again were able to have hands-on experience with microcomputers. The first part of the session focused on evaluation of software. The instructor introduced participants to using MicroSift, a software evaluation newsletter produced by the Northwest Regional Education Laboratory. Participants reviewed the basic components of the software review process. They also had an opportunity to discuss and share some of their experiences in working with local education agencies who have purchased or are considering buying microcomputers. The morning session ended with a discussion of some of the problems associated with advising potential microcomputer buyers about what equipment is right for them.

The afternoon session focused on reviewing the computer programs introduced in session 1. Participants were able to use microcomputers and rerun the programs they first used in session 1. The instructor spent time helping participants run the programs and clarifying for them the differences among writing, running, and storing a program.

Synopsis And Recommendations

Overall these sessions ran very well. There seemed to be a large drop off in attendance between the first and second sessions and between the second and third sessions. This can partially be explained because the second session was only two hours and involved no hands-on training. Additionally, because it was held at Sturbridge, many participants had quite long drives. Finally, the time of year may have affected attendance as many participants were very involved in reviewing proposals. The third sessions also had low attendance and this may be attributed to participants feeling that if they missed session two they would not be prepared

for session three. The lengthy time lag between sessions also may have contributed to the lack of attendance at the second and third sessions. Those participants who did attend all sessions seened very enthusiastic.

A variety of equipment problems also affected the sessions. The instructor recommended that in the future the same equipment should be used for all sessions.

In relation to particular sessions, the following recommendations were made by participants on the evaluation forms:

Session 1 - Use more examples related to specific Department of Education uses.

Session 2 - Have hardware available so participants can really examine differences among products.

Session 3 - Introduce more programs so that those participants who want to move at a faster pace can.

Overall, the most common reaction was that this type of training will really be useful if and when the department gets microcomputers.

5. MICROCOMPUTER LITERACY I

Instructor: Jan Braverman

Sites/Dates: 6/30/82 - Hubert H. Humphrey Occupational Resource Center, Boston
7/7/82 - Hubert H. Humphrey Occupational Resource Center, Boston
7/14/82 - Radio Shack Computer Center, Boston

Introduction To Topic

In order to knowledgeably handle approval of local education agency expenditures for microcomputers, state agency personnel required a hands-on introduction to these new technologies. This 3-session series (15 instructional hours) was designed to give staff members an introduction to the operation and uses of microcomputers in educational settings. The overall goal was to diminish staff anxiety about microcomputers through laboratory experiences.

Needs Prompting Training

During the spring professional development training, agency staff had the opportunity to participate in a pilot microcomputer training series called Microcomputer Literacy for Resource Persons. This series proved to be extremely popular. Microcomputer I represented a refinement based on the evaluation results of the spring program. The Microcomputer Literacy I series was a prerequisite for attending the other two microcomputer workshop series that were to be scheduled at a later time (i.e., Microcomputer II and III).

The purpose of all three of these microcomputer training sessions was to provide agency staff with basic information and hands-on experiences so that they would be better prepared to assist local education agencies in implementing the use of microcomputers in educational settings.

Training Objectives

Session 1:

A. Explain the names and purposes of the major parts of a microcomputer system.

B. Differentiating between hardware and software.

C. Teach procedure for turning on a microcomputer and running a program.

Session 2:

D. Explain the procedures for loading and running a computer-assisted instructional (CAI) lesson.

E. Explain the procedures for loading and running the LOGO language, and using direct commands.

Session 3:

F. Explain the procedures for loading and running a visible calculator software package.

G. Explain the procedures for loading and running a word processing software package.

Training Format

General Overview:

This series included three five hour workshop sessions. The first and third sessions were held at the Humphrey Center in Boston. The second session was held in the Radio Shack Computer Store Classroom in Boston. The format for each session was basically the same with variations in software and hardware being discussed, demonstrated and operated.

Specific Sessions:

SESSION 1: Participants were given a questionnaire on knowledge of microcomputer terminology and concepts and asked to complete a profile form for use in data collection. The instruments had been piloted in the Spring, 1982 Microcomputer Literacy Courses.

The session began with a one-hour introduction and demonstration of the parts of a microcomputer system. This introduction was reinforced by providing participants with a short pamphlet which reviewed the concepts and terminology of the demonstration.

For the remainder of this session, participants were given large group demonstration and individual laboratory-type instructions on operation of the following specific pieces of microcomputer software:

Typing Tutor - a computer assisted instruction package for practicing touch typing skills.

Salary - a program which computes three salary schedules (of five steps each) when given a base salary, step increments and scale increments by the operator.

Olympic Decathlon - a simulation of the activities of the Decathlon involving pressing certain keys to have figures go through activities.

SESSION 2: This session took place in the Humphrey Center. It included an introduction to the LOGO computer language and some computer-assisted instruction packages. The LOGO language was used in its turtle graphics mode to demonstrate user control of the computer and instruction in geometric concepts. Lessons on map legends and the Apple II keyboard were presented using Apple PILOT, a course-authoring language. The entire session was in the laboratory setting and involved cycles of discussion, demonstration and practice.

SESSION 3: This session took place at the Radio Shack Computer classroom on Commonwealth Avenue in Boston. The instructor demonstrated visible calculator and word processing programs. Participants were given specific exercises to carry out with each of the programs. The laboratory time was divided with one-third of the time devoted to word processing and two-thirds to the visible calculator program.

Word processing exercises included entering text, deleting text and inserting text. Printing text was demonstrated on a dot-matrix line printer.

Synopsis and Recommendations

This series was well received. Most staff members found the topics of interest and commented favorably on the clarity of presentation. While the majority of the participants felt comfortable with the pace of presentation, there was one comment per session on increasing the pace. In each session there were also participant comments on the comfortable pace at which this forboding topic was approached.

Comments on the evaluation forms were quite positive. Participants noted clarity and relevance of the sessions in particular. Comments also suggested that additional visual aids would have been beneficial in two of the three sessions.

These workshops represented a rather diffuse approach to the subject of microcomputer literacy. The following factors seem likely to enhance workshop quality in future sessions:

1. There should be greater control over the availability and organization of laboratory facilities. While facilities' owners and managers were quite cooperative, there were always fewer machines in working order than was desirable.

2. There should be greater availability of training materials (especially visual aids). As this field develops further, there will be more and more quality training materials off the shelf. When compared, for example, to the level of visual aid development in vocational electronics instruction, there is virtually nothing available in computer literacy which is of value to adult professional audiences.

3. Smaller groups or an instructional assistant knowledgeable in microcomputer software and hardware should be considered. This would permit greater individualization for people who need a faster or slower pace than the average participant.

6. MICROCOMPUTER LITERACY II

Table of Instructors/Sites/Dates

Instructors	Site	Date	Session #
	BOSTON SERIES		
J.Braverman	Radio Shack-Bos.	July 28,1982	Session 1
C.Parham	Humphrey Center	Aug. 11,1982	Session 2
J.Braverman	Humphrey Center	Aug. 18,1982	Session 3
	WORCESTER SERIES		
J.Braverman	Worcester State	July 1,1982	Session 1
M.Walker	Radio Shack-Wor.	July 8,1982	Session 2
J.Braverman	Radio Shack-Wor.	July 15,1982	Session 3
	FITCHBURG SERIES		
J.Braverman	Fitchburg State	Aug. 2,1982	Session 1-A
M.Walker	Radio Shack-Bos.	Aug. 2,1982	Session 1-B
J.Braverman	Fitchburg State	Aug. 2,1982	Evening Lab
J.Braverman	Fitchburg State	Aug. 3,1982	Session 2-B
J.Braverman	Fitchburg State	Aug. 3,1982	Evening Lab
M.Walker	Radio Shack-Wor.	Aug. 3,1982	Session 2-A
J.Braverman	Fitchburg State	Aug. 4,1982	Session 3
J.Braverman	Fitchburg State	Aug. 4,1982	Evening Lab

Introduction To Topic

Microcomputer Literacy II was designed as a continuation of Microcomputer Literacy I. As such it was a hands-on workshop series introducing new technology. This 3-session series was intended to give staff members a greater degree of familiarity with the major microcomputers and associated software introduced in Microcomputer Literacy I. The overall goal was to increase staff knowledge about microcomputers through laboratory experiences.

This series was offered three times in three different regions of the state. The Boston and Worcester series were offered on a weekly basis for three consecutive weeks. The Fitchburg series was offered as part of a week long residential program at Fitchburg State College. The purpose ot this residential program was to provide a more intensive training experience where participants had the opportunity to take optional evening laboratory sessions as well as attend the day sessions. The Fitchburg series combined both the Microcomputer Literacy II and III curriculums.

Training Objectives

Session 1:

A. Constructing a visible calculator worksheet application.

B. Formatting text on the screen and for printing with word processing.

Session 2:

C. Explaining the procedures for loading and running a microcomputer data base software package.

Session 3:

D. Explaining how to construct procedures in the LOGO language.

E. Using LOGO procedures.

Training Format

General Overview:

This series consisted of three five-hour workshop sessions. The program sessions were held at a variety of sites as noted above. The format for each session was basically the same with a wide variety of software and hardware being discussed and operated. The Fitchburg sessions paralleled the others but were more intense with the addition of two-hour evening laboratory sessions.

Specific Sessions:

During the first session, participants were given a questionnaire that was designed to test their knowledge of microcomputer terminology and concepts and also asked to complete a profile form for use in conjuction with this data. The instruments had been piloted in the Spring, 1982 microcomputer literacy courses.

In each session, participants were given a large group demonstration of each software package. Underlying concepts related to the user's point of view were discussed. Specific directions for operation were placed on flip charts and blackboards. This was followed by extensive laboratory time with the instructor moving around the room to repsond to questions as participants operated the software.

These sessions used the following specific pieces of microcomputer software:

DB Master and ERIC MICROSEARCH: These packages were used to demonstrate the fundamentals of database organization. The specific parts of a database were discussed. Participants used the database software to enter and search for specific records.

LOGO (MIT Version 2): Participants learned to construct procedures in this computer language.

SCRIPSIT: Word processing concepts were demonstrated and practiced to illustrate potential productivity increases with this part of computer technology.

VISICALC: Participants learned to construct a simple spreadsheet application with this software on the TRS-80 Model III.

Synopsis and Recommendations

This series utilized a more informal style of presentation due to the previous experience of most staff members. Comments on the written evaluations were generally positive. Participants found this second series somewhat easier to relate to their professional role needs as it involved more detailed examination and use of software.

As with Microcomputer Literacy I, the following recommendations apply to these type of instructional goals:

1. There should be greater control over the availability and organization of laboratory facilities. While facilities' owners and managers were quite cooperative, there were always fewer machines in working order than was desirable.

2. There should be greater availability of training materials (especially visual aids). As this field develops further, there will be more and more quality training materials off the shelf. When compared, for example, to the level of visual aid development in vocational electronics instruction, there is virtually nothing available in computer literacy which is of value to adult professional audiences.

3. Smaller groups or an instructional assistant knowledgeable in microcomputer software and hardware should be considered. This would permit greater individualization for people who need to go faster or slower than the average participant.

4. An effort should be made to group participants according to their backgrounds. With such a short amount of available teaching time it was difficult to meet everyone's needs with such a heterogeneous group.

7. MICROCOMPUTER LITERACY III

Table of Instructors/Sites/Dates

Instructors	Site	Date	Session #
	BOSTON SERIES		
J.Braverman	Humphrey Center	Aug. 25,1982	Session 1
J.Braverman	Humphrey Center	Sept. 1,1982	Session 2
	WORCESTER SERIES		
J.Braverman	Worcester State	July 22,1982	Session 1
J.Braverman	Worcester State	July 29,1982	Session 2
	FITCHBURG SERIES		
J.Braverman	Fitchburg State	Aug. 5,1982	Session 1
J.Braverman	Fitchburg State	Aug. 6,1982	Session 2

Introduction To Topic

In the process of reviewing grant proposals, agency personnel need some sense of the specific hardware and software offerings of various manufacturers and vendors. Similarly, there is a need to understand the ways in which purchasers interact with high technology vendors. Accordingly, this 2-session series was designed to give staff members exposure to a variety of hardware and software in vendor presentations, demonstrations and question-and-answer periods. Additionally, issues of hardware & software needs assessment were discussed. Participants were provided with frameworks to guide their evaluation of both hardware and software purchases.

Training Objectives

Session 1:

A. Using a pre-defined format, participants will evaluate computer-assisted instruction software.

Session 2:

B. Using a pre-defined format, participants will evaluate computer hardware.

Training Format

General Overview:

This series included two five-hour workshop sessions. The format for each session was essentially the same with software being considered in the first session and hardware being discussed in the second session.

Specific Sessions:

SESSION 1 (Software): The MICROSIFT courseware evaluation format was discussed and applied to specific pieces of software which participants had an opportunity to use. Computer-assisted instruction software was demonstrated by J.L. Hammett as part of the evaluation process.

The MICROSIFT format provides some general guidelines for deciding on the appropriateness of particular software for instruction applications. Participants were given a descriptive booklet which included a form for use in the evaluation process. Sample evaluations from the Northwest Regional Education Laboratory were also reviewed with participants.

SESSION 2 (hardware): Each of the major microcomputer hardware vendors was invited to make a specific sales presentation to provide participants with some laboratory experience in evaluating vendor claims. A series of questions were presented for staff members to ask in screening vendor claims. The instructor commented upon the vendor presentations as part of a follow-up discussion.

Synopsis and Recommendations

The evaluation forms indicated that participants were generally quite pleased with these programs. However, this series could be improved by locating it in a setting which contained (on a permanent basis) each major microcomputer and a sizeable library of software. It is not always advisable to rely upon vendors to present a sufficient variety of hardware and software or, in some cases, to even send knowledgeable personnel for the demonstration. Such a facility would also be a resource to local education agencies in attempting to make purchase decisions and train staff.

8. ADMINISTRATIVE APPLICATIONS FOR MICROCOMPUTERS

Instructor: Jan Braverman

Dates/Sites:		
	9/8/82 & 9/9/82	- Dept. of Educ., Quincy
	10/1/82	- Univ. of Mass., Amherst
	10/8/82	- Univ. of Mass., Amherst
	10/18/82	- Univ. of Mass., Amherst
	10/21/82 & 10/22/82	- Univ. of Mass., Amherst
	11/8/82	- Univ. of Mass., Amherst

Introduction to Topic

After a decision had been reached to use microcomputers for administrative applications within the agency, it was decided that a series of highly individualized introductory training sessions were needed for small groups of administrators. For the most part, the participants in these training programs occupied middle to upper level management positions within the agency and had not been involved in any of the previous training.

Training Objectives

A. To introduce participants to selected administrative uses for a professional microcomputer. The software to be demonstrated included word processing, electronic spreadsheet, and data base management.

B. To provide participants with an opportunity to operate a professional microcomputer.

C. To provide participants with an opportunity to discuss various administrative applications for professional microcomputers within the agency.

Training Format

The Administrative Applications for Microcomputers series began with four short introductory sessions (1 1/2 hours each) that were conducted in the Department's Quincy offices. The response to these short sessions was quite positive and subsequently resulted in an expanded version of this training being conducted at the Institute's Amherst offices. Instructional groups ranged from four to six participants. Each group either worked within the same division or occupied comparable management positions within different organizational units.

IBM Personal Computers were used for this training with no more than two participants using each unit. Both dot-matrix and letter quality printers were available. The training included an informal discussion of microcomputer

capabilities followed by instructor demonstration and participant use of three types of software. These included word processing (Wordstar), an electronic spreadsheet (Supercalc), and a data base management system (dBASE II). The instructor used current information from the Department to develop introductory level Supercalc and dBase II programs that were appropriate for each of the groups. In several of the programs, the use of a modem connection to the state college computer system was also demonstrated.

The instructor's approach varied considerably in response to different levels of participant knowledge about microcomputers as well as diverse administrative responsibilities within the organization. This required a considerable amount of preparation time since it was necessary for the instructor to understand the functions that were performed in each organizational subunit as well as the job responsibilities for each of the participants.

Synopsis and Recommendations

Participants commented favorably on the effectiveness of the informal style as well as the responsiveness of the instructor to participants' organizational roles and functions. The use of current department information in the Supercalc and dBASE II demonstration programs was also considered valuable in helping participants understand how microcomputers could be used in the agency. Participants also responded positively to their opportunity to use a business microcomputer and indicated an eagerness to proceed with the task of incorpo-rating the use of microcomputers into the administrative functions of the agency.

This workshop series for administrative personnel was the final phase of awareness training that had been arranged for professional personnel before the microcomputers were scheduled to arrive in the agency. Based on the information that we have received from program participants and from our discussions with other agency personnel, it is our judgement that many staff members throughout the organization are now receptive to the use of microcomputers. We have recommended that major attention now be focussed on the task of training personnel to use the new microcomputers.

CHAPTER VIII

AWARENESS TRAINING TECHNIQUES

Introduction

In our definition of computer awareness, we pointed out that the content and structure of training should take into consideration the acquisition of knowledge and the development of skills in three basic areas. The first is the cognitive area, where factual information about microcomputers should be provided at a level of sophistication that the trainees can understand and absorb. The second area includes affective issues since participant fears, doubts, and negative feelings about computers must be dealt with in a responsive and supportive manner. Finally, individual variations in human/machine interaction patterns must be accounted for and integrated into the learning process. For example, back problems, bifocals, color blindness and level of typing skill are all human/machine interaction variables that can effect learning.

Our experience with state agency personnel has led us to believe that certain training techniques are more appropriate than others in responding to this definition of computer awareness training. This chapter includes our observations about those training techniques that we found to be most effective. However, it is important to remember that we offer this information in the form of tentative recommendations since the content, facilities, equipment, instructors and methods used for gathering evaluation data varied somewhat among the training programs. Our observations on instructional techniques will focus first on those elements that should be considered prior to training, then discuss how the training should be carried out, and finally provide some suggestions for evaluating awareness training programs.

Participants

The first issue that should be addressed in setting up an awareness training program is the nature of the participant grouping and the organizational context within which training is taking place. We found that one of the most effective ways of organizing participants for instruction was to group them by areas of work responsibility. This approach allowed us to focus the training on specific job related applications that were much easier for the trainees to translate back into their work environment. For example, personnel from several levels in various divisions of the agency could be included in a group that was learning how to use an electronic spreadsheet to handle financial and personnel projections.

Another major consideration in the formation of trainee groups is the level of participant knowledge about microcomputers. Participants with very little previous knowledge about microcomputers need to proceed much more slowly than those people who have already had some experience with microcomputers. In addition, those personnel who are familiar with the operation of mainframe computers need a different type of awareness training than staff members who have never worked with any type of computer. In those cases where participants do have different levels of knowledge about the microcomputer, it is especially important to provide an opportunity for individuals to proceed on their own.

We believe that it is possible to use microcomputer training as a mechanism for building group cohesiveness both within and across organizational units. The cooperation and mutual support that is generated in the process of struggling together to acquire new skills can result in positive long term organizational benefits if the training groups are selected with this in mind. Although such an approach is probably more effective with a training group made up of people who have never worked together, we suspect that this technique would also be appropriate for use with personnel who have previously experienced some difficulty in working together.

Within a training environment, the newness of microcomputers can also legitimize a temporary equality in status that encourages mutually beneficial interaction across different levels of the organizational hierarchy. However, care should be exercised so as to avoid creating groups where people may feel vulnerable in each other's presence (e.g., executives and their secretaries). This difficulty can be avoided by emphasizing the skill or knowledge that is to be acquired in each training session, providing information about the range of participants, and allowing individuals the option of acquiring needed skills through some other means.

Participants and Equipment

The size of a group should be based on the number of microcomputers that are available. Under the best of circumstances, we would recommend that each participant have their own microcomputer. We have found that assigning more than two participants to a microcomputer usually compromises the effectiveness of the human/machine interaction part of the training. In those cases where two learners share a micro-computer, we have found that time on the equipment must be monitored so that each participant has equal access to the microcomputer. Inequitable use of the equipment seems to happen for two quite different reasons; some participants use more than their share of time while others are reluctant to use the equipment at all. This diversity in approach to the

use of equipment must be taken into consideration when the participants are assigned to the microcomputers.

Instructors

In developing effective microcomputer training programs, instructors should be selected who possess the following characteristics: (1) knowledge of microcomputers, (2) experience in the use of the equipment and software that will be used by the trainees, (3) familiarity with the trainees' work environment and responsibilities, (4) effective communication skills, and (5) the ability to structure learning situations that are responsive to adult needs. Although it is unlikely that you will be able to find trainers with all of these attributes for every microcomputer related training task in your organization, it is important to select the best talent that is available.

Recognizing and selecting appropriate instructional talent for microcomputer awareness training can be difficult, especially if the person responsible for the decision is not familiar with microcomputers. After selecting an instructor, it is equally difficult for many people to supervise training efforts that fall outside of their areas of expertise. One way of approaching this problem when you do find instructors who looks promising is to hire them for short term programs with clearly defined limits that can be carefully observed and evaluated. It also will be useful to obtain feedback from the staff members an instructor works with in planning a session. Finally, you may wish to obtain an outside review of training materials that are developed by the instructor before contracting for additional work.

Laboratory training sessions work best when there is a ratio of one instructor or instructional assistant for every four microcomputers being used. Under such an arrangement, the instructor would make all of the laboratory presentations and circulate among the entire group of trainees while they are using the microcomputers. The instructional assistants would not need to be as sophisticated in their understanding of the topic or as skilled in their training techniques as the instructor. The assistants would provide help on some of the basic questions that typically occur when participants first begin to use the microcomputer (e.g., starting the equipment, loading the software, or figuring out what to do next at any point in the exercise).

School aged children and youth who are familiar with the use of microcomputers can be used very successfully as instructional assistants in microcomputer training programs. This approach creates access to an expanded and relatively inexpensive talent pool that can be used to provide some of the individualized assistance that is needed for beginners in microcomputer training programs. Especially when training teachers and personnel from state education agencies, the use

of knowledgeable elementary students can serve as a reminder of the rapid changes that are taking place in society. When designing microcomputer training programs for private and public sector personnel, the use of high school and college students can illustrate the levels of skill that have been developed by young people who are about to enter the world of work.

Instructor assessment of the needs of specific participants is an ongoing process that continues throughout the training. Much of the instructor's assessment can be conducted while circulating and watching people work with the microcomputers. Adults are very receptive to this type of informal and unobtrusive evaluation of their progress, especially if individual help is provided in a supportive and encouraging manner. With this approach, it is possible to identify those participants who require more reinforcement and assistance.

Instructional Content

The instructional content of the training includes both general information about microcomputers and specific job related applications for the technology. General computer awareness content should be offered at two different levels. At the outset of a training program, it will necessary to function at an introductory level where careful explainations are provided regarding such components as the names and purposes of the major parts of a microcomputer system. This level would also include non-technical definitions for both hardware and software. Preliminary explanations such as these form the lower level of general computer awareness.

The more advanced level of general computer awareness would involve activities such as discussing and demonstrating characteristics of hardware from various microcomputer manufacturers. This assumes some trainee experience in using one or more of the major microcomputers, and participants are usually able to profit most from this type of instruction toward the end of a training program. This type of training can best be accomplished in a laboratory setting that has a variety of microcomputers.

The second type of instructional content is based upon specific job related applications for the microcomputer. In our training for state education agency personnel, we selected microcomputer software that would demonstrate a clear relationship between the exercises that participants carried out on microcomputers and their administrative and technical assistance responsibilites within the agency.

Individualization Of Instruction

Individualization of content, pacing, sequencing of material, and variation in learning approaches also need to

be considered in developing effective training programs. While the use of multiple track learning options may not be appropriate or cost effective within every training program, starting with the assumption that microcomputer training should be individualized will result in greater responsiveness to the unique needs of each staff member.

Individualization can often be achieved by carefully integrating large group presentations, small group interaction, and private instruction (e.g., small group tutorials, peer assistance, and working alone on the computer). Other techniques that can help to individualize microcomputer training programs include the following: (1) use of small instructor/participant ratios; (2) availability of several instructors with different backgrounds, content orientations, and presentation styles; (3) access to a wide range of reading materials; (4) availability of self-pacing computer based instructional programs; and (5) access to someone in the organization who has had experience using the program.

Facilities

Since the Institute did not own any microcomputers when we began to offer these awareness training programs, it was necessary to arrange for the use of training facilities in public schools, a library, state colleges and universities, retail computer stores, and the state education agency. In every instance, the people who helped us arrange for the use of these facilities were very responsive to our needs. At the same time, borrowing facilities and equipment from other people can result in some major difficulties. In part, this was a reflection of the time; in the early part of 1982, very few organizations had sufficient numbers of microcomputers or appropriate software for the type of laboratory experiences that we were interested in providing. This was particularly true in trying to meet the instructional objectives that we had developed for administrative tasks within the agency. Within the next several years we expect that this shortage of hardware and software for training will ease considerably.

Having enough equipment available and operating at the same time often involved borrowing extra microcomputers and hauling them to the training site. We frequently had to temporarily remove components from non-working microcomputers so that we could put together one more functioning machine. On one occasion, an instructor's car was stolen in Boston along with two borrowed microcomputers and a variety of other equipment and software. Although this borrowed equipment had been insured by the Institute, the loss of the equipment and software did create a number of problems for our training schedule.

Arranging for the equipment to work properly was often our major concern. We found that in those cases where the microcomputers were already on site, it was usually necessary

for a staff member to spend at least two hours checking out the equipment before each training session. When we also brought additional units or had to make major adaptations to the equipment that was on site, our staff and instructors usually spent the evening before a scheduled training session making all of the necessary arrangements.

Arranging for the proper equipment was the most difficult and time consuming issue that confronted us in setting up an appropriate environment for the awareness training programs. However, there were a also a number of additional elements that we considered in selecting the training facilities. These included proper lighting, chairs and tables that would be comfortable when used with microcomputers, availability of additional instructional rooms near the computer laboratory, temperature and humidity control, level of noise, security for equipment during breaks, and availability of audio visual equipment, blackboards, and other instructional aids. We were also concerned about convenience elements such as transportation access to the site, parking arrangements for participants, eating arrangements for meals, and a separate nearby room for coffee breaks and relaxing.

Although none of our sites met all of the requirements, some of the state college facilities worked out quite well. The major drawbacks of the school system facilities were the lack of microcomputers that were usable for administrative applications and the problems that adult learners had with furniture that had been designed for elementary or high school students. The retail computer training facility usually consisted of a small room that seemed rather crowded when filled with a group of trainees. The number of microcomputers that were available at the retail stores also varied somewhat depending on their inventory on the day of the training program.

Scheduling

The amount of time that we used for awareness training ranged from 1 1/2 through 50 instructional hours. At this point, we would recommend the scheduling of awareness training programs that are between one and three days in length. Less than one day in duration did not allow time for the type of informal question and answer sessions that many of the participants seemed to value. In addition, at least one full day is needed for trainees to spend sufficient time using the equipment. The one day sessions seemed to be most effective when focussed on a limited number of applications for the microcomputer (e.g., administrative uses for an electronic spreadsheet and a data base management system) and when used with small groups of 2 to 6 participants.

The one day format turned out to be a very useful length of instruction time for short-term awareness training. A single day of training can either be provided in isolation or

linked with subsequent days of training without detracting in a major way from the normal organizational work that is expected from trainees. While one day may seem like a limited amount of time in which to develop microcomputer awareness, there are some important experiences that can be provided to professional staff. These experiences can then serve as a foundation for the more specific, job-related training that occurs after the equipment arrives. Short term introductory workshops also can provide participants with an indication of what there is to learn about microcomputers in the future.

Two or three day sessions are needed with larger groups of 20 to 25 participants, especially when they were interested in both technical assistance (e.g., instructional usage in the schools) and administrative applications for microcomputers. For this type of training, we would recommend scheduling the sessions one day per week over a series of two or three weeks. When training extended beyond a three day period, participants seemed to move out of the awareness stage to the point where they needed orientation training in the use of specific hardware and software. This type of orientation training is most effective if it occurs after microcomputer equipment has been installed in the work place.

Although the five day residential training program was very well received, at this point we would probably reduce the length to three days for any future residential training programs. Beyond that time frame, there appeared to be a slight decline in the level of productivity for both participants and instructors. Most of the participants also had some difficulty arranging to spend an entire week at the training program.

Setting The Climate For Training

An appreciation of the applications for microcomputers is most effective when gained through firsthand experience. Since computer technology in general is an abstract, somewhat foreign notion to most non-technical professionals, there is a need to reduce it to as concrete an idea as possible. Even when a trainee is involved personally with a microcomputer, there are many unfamiliar notions to be handled. Few adults who merely read about microcomputers seem to have a sense of what the technology is or what it can do. Reading may appropriately precede or follow firsthand experience but is not a viable approach to learning about the technology in and of itself.

In keeping with the assumptions about how foreign these topics are, it is important to provide frequent reassurance to trainees about the frustrations of this type of learning experience. Reassurance plays a significant role in any learning process and is especially important when dealing with these seemingly mysterious technological concepts.

It is also important to select instructors who can provide reassurance while being accepted as an authority on the subject matter.

The microcomputer revolution is of fundamental importance to the whole training process. Participants need to know that the mass marketing of microcomputers has had a profound impact on access to the technology. The simplification of the technology has increased its marketability on a broader scale. Knowing that this is a major thrust of the marketplace is of significance to non-technical learners and can be very reassuring. Mass marketing has also encouraged manufacturers to develop equipment that can be controlled by people in our culture who have a relatively low level of technical awarenesss and sophistication.

Establishing Parameters For The Training

It is important in awareness training programs to establish parameters for the training before it takes place. When a technology is new it is very easy for people to believe that they have become experts after only a brief exposure. Without dampening the enthusiasm of participants, an instructor or coordinator should clearly explain some minimum and maximum goals that can be achieved in the time allocated for the training. These goals will obviously fall short of the skill levels attained by various computer professionals and this should be evident to participants.

Some participants will find it useful to compare the goals of an awareness training program to those that are typically established for a college course on a similar topic. This will also provide some idea of what else there is to learn about computers through other, more formal resources. Since most college courses emphasize the acquisition of programming skills, it is also important to remind participants that they do not need college level programming courses in order to use microcomputers in their work.

Participants should be informed that awareness training relates most directly to operating rather than programming microcomputers. Distinguishing between these concepts is crucial during the initial phase of awareness training since most of the non-technical participants will arrive at the training session with the expectation that they must eventually learn programming skills. General, short-term awareness training cannot hope to promote significant programming skills.

Introducing The Training

Having established a framework for the training, it is important to place the topic of the day in that framework. Participants need to have a sense of sequence and purpose for

each of the workshop sessions. Opening a workshop session involves telling participants what will be done with the computers on that day and why it is done on a computer as opposed to some other medium. We found that it was quite helpful to use the initial session of each training program for a brief lecture that helped place subsequent workshop events in the proper perspective.

After the introductory lecture, a demonstration of an actual computer process can be used to convey a fairly exact sense of what will happen during the training program. Seeing the instructor carry out a particluar process of interacting with the computer also is helpful in removing some of the mystery. Where possible, it is useful to demonstrate this process on the computer using multiple screens connected to the same computer so that all of the participants can view the screen without difficulty. This can be accomplished in many situations simply by connecting the screens with cables.

Using The Microcomputers

Laboratory type practice activities should follow the demonstration. At early sessions in the workshop, participants should have an opportunity to merely replicate what they have seen the instructor demonstrate. At a later point in the workshop, participants can be given practice activities which parallel the demonstration but have slightly different outcomes.

Instructors who provide awareness training for people who are completely unfamiliar with microcomputers need to be especially cautious about overloading the learner with information. For example, it is easy to exceed a beginner's capacity to string together individual processes into long tasks. Segmenting the tasks in manageable portions helps participants get started. The length of tasks and processes can gradually be increased as people become more comfortable with microcomputers.

Operating a microcomputer involves a good deal more in the way of assumptions than is often realized. It is important to explain assumptions of all kinds while giving a practice task. An example of an often unexplained assumption is the need to touch an "enter" or "return" key after typing some command. This is often taken for granted by people who are frequent users of computers. It is not in any way part of the assumptions with which a beginner approaches a microcomputer.

During the microcomputer laboratory sessions the instructor should bring the entire group back together at various points to review, explain or provide information regarding the next steps that participants will follow. Except for these occasional group discussions, the laboratory

practice activities would follow an individualized learning pattern with support and reinforcement provided by the instructor and the instructional assistants.

Repeating a demonstration at an individual workstation can also serve as a very effective instructional technique. When an instructor demonstrates a particular microcomputer process to the entire group, it may be difficult for some individuals to follow all of the steps that are being taken. Repeating the group demonstration several times for individuals and small clusters of learners at their microcomputers gives them another opportunity to observe the particular step that has been giving them difficulty. This not only helps learners overcome some of the initial hurdles, it also provides them with reassurance at a stage when they are uncertain about using the microcomputer. It also is helpful to bring the group together again toward the end of the laboratory session in order to review a process that was confusing to a large number of participants.

Concluding The Training

A brief summarization lecture followed by a discussion that includes a question and answer period can serve as an effective way of concluding each day of training. In any question and answer period, participants must be made to feel quite comfortable in asking what may seem to them to be naive questions. Beginning users of microcomputers frequently start their questions with the phrase "this may be a dumb question, but...". The instructor can develop an appropriately supportive atmosphere by providing serious and direct responses to all types of questions.

Instructors should avoid making comparisons or comments about group achievement. Many instructors feel a need to let participants know that they were unable to cover all of the material planned for a particular workshop. While this may often be true since any good instructional plan should include more activities than time allows, it is unwise to communicate this to participants. This type of message only serves to reinforce anxiety about the amount of technical information that still must be learned by the participants.

It is also important for the instructor to provide a good deal of reassurance about frustrations which participants may have encountered as they tried to use and understand the microcomputer. It helps to provide illustrations of typical misunderstandings that occur among individuals who have recently been introduced to the use of microcomputers. This is especially valuable for those participants who leave a training session still feeling slightly confused about the microcomputer. This will probably occur at every workshop session since it is unlikely that every participant in a workshop will fully understand all of the procedures or concepts taught. Adult learners need acknowledgement that

some parts of the technology will remain unclear for many people both during and even after they participate in training.

In those cases where training takes place over several days, each daily session should end with a brief description of the activities that will take place on the next day that training is scheduled. At the final workshop session in a training program, the instructor needs to provide specific examples of where participants can go in order to further develop their knowledge about microcomputers. Additional learning resources can range from informal sources like computer exhibitions to formal sources such as college courses. Some people will feel a certain urgency about receiving additional training. This perceived need is promoted in part by the present climate of technological revolution that surrounds professional personnel in our society. It is especially easy for educators to feel very uncomfortable about their lack of microcomputer knowledge.

Providing Support Materials

Both group and individual visual aids should be employed generously in every awareness training program. Group visual aids include the use of flipcharts, overhead projectors and blackboard displays which show exactly what the user of the computer must type on the keyboard and what the microcomputer does in response. This frame of reference is important in helping people know exactly what to do as well as anticipate what the microcomputer will do. Visual aids on what to touch and what to type should be prominently displayed in the learning laboratory and also be provided to each participant in handout form so that they can make notes and comments on their own quick reference sheets.

Documentation of the processes that will occur as an individual uses the microcomputer can be a valuable teaching supplement in laboratory sessions. The instructor should provide individual visual aids at each workstation that illustrate how the screen will appear at each step in the process. The participants can then compare their actions and the results with those represented on the individual sheets. This type of visual aid is an essential part of the documentation which should come with every microcomputer. Users of microcomputers should expect this type of documentation and raise questions when it is not available. Training people with such visual aids also will increase their awareness regarding the appropriate use of visuals in facilitating any microcomputer process.

A glossary of command words and rules that are being used during the training should be available as a handout for each trainee. This material will be useful as a reference both during and after the workshop and will also allow some of the more advanced students to proceed on their own. It is

also helpful if participants have individual copies of a keyboard diagram that includes explanations peculiar to the software that is being used in the workshop. For example, such a diagram would explain how control keys are used in different ways by different programs.

In awareness training, the instructor must set limits to the amount of information that can be covered. However, the amount of knowledge that can be acquired by trainees can be extended by using appropriate follow up materials. Follow up readings can be of significant value to short term training participants. Issuing bibliographies and copies of articles during the training and at the final session can give the more interested participants a starting point for further development of skills.

Evaluating The Training

An evaluation form was used to obtain the reactions of participants to each of the training programs. Institute staff and instructors also held numerous informal discussions with participants during the training programs as well as a series of follow-up interviews with selected participants after training was completed. In addition, a multiple choice questionnaire was used in the microcomputer literacy programs (programs 4 through 7) to gather data regarding participant acquisition of factual information about microcomputers. A personal data sheet was also completed by participants in programs 4 through 7 that provided background information on items such as previous computer training, educational background, and responsibilities in the organization.

In analyzing the information that had been gathered, we focussed our attention on the following concerns: (1) the development of descriptive information about the training programs; (2) discovering which training sessions were most effective; (3) identifying unmet organizational and trainee needs; and (4) determining which aspects of the hardware and software required specialized attention during the awareness training phase.

Since microcomputer awareness training is a relatively recent development, we found that there was very little agreement in the literature or among instructors regarding what should be taught or how the learner might best acquire the appropriate knowledge or skills. This diversity of opinion about the content and structure of microcomputer awareness training made the task of developing effective evaluation instruments rather difficult.

As a result, we approached the task of evaluating the training in several different ways. Project staff members developed a comprehensive evaluation form to be administered to participants at the completion of each training session. This form asked participants to rate the following items:

achievement of course objectives; usefulness of information presented; instructor effectiveness; desire for further training; and work-related areas where new skills could be applied. The form also included space for participant comments on how to make the programs more applicable to their jobs, how the instructor might better have met their needs, and recommendations concerning the site. Upon receipt of the completed questionnaires after each training session, the project evaluator summarized the results and circulated them among the project staff.

We also developed an instrument that included a series of multiple choice questions covering factual information about the use of microcomputers. This questionnaire was administered to participants at the beginning and end of each of the microcomputer literacy training programs (programs 4 through 7). The data from this questionnaire did give us some indication regarding which participants demonstrate the greatest growth in the acquisition of factual knowledge about microcomputers. Not surprisingly, the greatest increase in factual knowledge occured among those participants with the least amount of previous experience with computers. Although this type of cognitive growth turned out to be relatively easy to measure, we suspect that the acquisition of factual knowledge about microcomputers is far less important than the growth that occured in the affective area or the changes that were necessary for some people in their interaction patterns with the equipment.

Growth in these non-cognitive areas is difficult to quantify even when there is general agreement regarding the content and structure of the training. As a result, we relied heavily on the use of qualitative data gathering techniques (e.g., unstructured interviews and participant observation techniques) in order to generate descriptive information about the following two areas: (1) the learning processes that were occuring in the affective area; and (2) the types of difficulties and approaches to adaptation that seemed to be occuring in human/machine interaction patterns. As our research efforts continue, we expect that the availability of an expanded base of descriptive data about these aspects of microcomputer training will enable us to refine and expand our evaluation techniques.

In this chapter, we have provided some of our preliminary observations regarding training techniques and processes that may be helpful to the reader who is interested in designing effective microcomputer awareness training programs. In the next chapter, we will broaden this perspective considerably by discussing how microcomputer awareness training fits within the larger context of a comprehensive training and support system.

CHAPTER IX

THE DESIGN OF A TRAINING AND SUPPORT SYSTEM

Microcomputer awareness training is just one step in the establishment of a training and support system that can provide continuing organizational support for the acquisition and use of microcomputers. This section will describe one approach to the design of such a training and support system.

Developing an organizational training and support system for microcomputers includes activities such as the following: (1) conducting a microcomputer-related survey of personnel; (2) developing an organizational plan for providing training and support; (3) identifying and training resource personnel; (4) establishing a microcomputer support center; (5) awareness training sessions that occur before the equipment arrives; (6) orientation training that occurs immediately after the microcomputers are in place; and (7) specialized training for selected groups of personnel. Each of these activity areas will be discussed sequentially.

Conducting A Microcomputer Related Survey

The first step is to conduct a survey designed to gather information about microcomputers from your staff. In any organization, people will have different levels of knowledge and diverse perceptions regarding the potential usefulness of microcomputers. The primary reason for conducting such a survey is to gather information that will provide an overview of the knowledge, skill levels, perceptions and suggestions that people have regarding microcomputer usage. A secondary purpose for conducting such a survey is to involve people in shaping a decision (the introduction of microcomputers) that will dramatically restructure their working environment. Finally, such a survey will function as an initial awareness training step since responding to questions about microcomputers will generate curiosity and raise levels of consciousness about the topic area.

The data gathered in such a survey may also help to ease the concerns of those data processing personnel and top executives who view the introduction of microcomputers as leading to a loss of quality control over the information that is used by managers and other professional staff. Since there has already been a dramatic increase in the use of "unofficial" microcomputers by managers and professionals in many organizations, the survey will document where these units are and how they are being used.

This type of survey can be developed by a team made up of several staff members and consultants. The team should be knowledgeble about microcomputers, familiar with instrumentation and survey design issues, understand the organization's

mission, and have had experience working with a wide range of personnel in the organization or in similar organizations. The team's initial task would be to to develop a survey instrument for gathering data on topics such as as the following:

1. The respondents' level of knowledge, skills and prior experience with microcomputers.

2. The respondents' readiness to use a microcomputer as well as their perceptions of the functions it should perform.

3. The respondents' preferred approach to learning about microcomputers (e.g., group instruction, private tutorial, or reading the manuals and using the equipment).

4. The respondents' interest in developing the microcomputer related skills of subordinates.

5. The respondents' perceptions of how the use of a microcomputer might increase or decrease productivity in their unit of the organization.

6. Information on existing microcomputer hardware and software configurations as well as the way in which the existing units are being used.

7. The respondents' willingness to serve as resource persons in selected software application areas.

After completing the survey and subsequently collecting and analyzing the data, the survey team should use the information to develop an interview guide. This guide would then be used by team members to conduct in-depth interviews with selected executives, managers, data processing personnel, other professionals, and support staff in order to obtain additional information regarding potential uses for microcomputers within the organization.

Using data obtained from both the survey instrument and the interviews, a preliminary report of the findings would be developed by the survey team. These preliminary findings would be reviewed by a selected group of managers, data processing personnel, and top executives prior to the development of the final report.

Development of A Training and Support Plan

The process involved in generating a microcomputer training and support plan can help to identify and integrate the diverse needs of various users and, in addition, insure that efforts in this area support the organization's mission. Developing a plan is a useful step because it will enable you to identify and use talent from within the organization,

integrate your training efforts with the equipment and software purchasing schedule, help managers and data processing personnel work more effectively with each other, and serve as a guide in coordinating training and support activities throughout the organization.

The previously conducted survey can provide much of the information that is needed to develop such a training and support plan. Responsibility for coordinating the development of the training plan should be given to a non-technical manager who is interested in the assignment, works well with others, and occupies a position relatively high up in the organization. It is also helpful if this individual was involved in carrying out the survey.

The use of a top level non-technical manager in this key coordination role will help to provide a clear signal regarding the anticipated spread of microcomputers throughout the organization and also prevent the microcomputer training and support plan from being identified too closely with the existing data processing department. At the same time, it is very important that the coordinator involve data processing personnel as well as a variety of other professional and support staff in this effort. If consultants are used in this phase, their role would be to provide technical information, advice, and support to the coordinator as the plan evolves.

The primary purpose of the plan is to provide staff members with an understanding of the general direction that is being taken by the organization regarding the use and support of microcomputers. The training and support plan should contain detailed information on all microcomputer related activities that are anticipated during the six month period following the distribution of the plan. Extensions and modifications should be added every three months after the original plan is distributed.

Examples of components that might be included in such a plan include descriptions of the hardware and software to be purchased, a preliminary listing of resource personnel, an overview of the services to be provided by the microcomputer support center, and time schedules for the awareness and orientation sessions. Additional information that is unique to the organization should be included as necessary.

Identification and Training of Resource Personnel

Encouraging the development of resource personnel is critical to the successful use of microcomputers within any organization. Assistance must be readily available at the time when a problem occurs or your staff will become frustrated and discouraged. As a result, much of this assistance must come from within the organization. Since many of the problems that occur can be solved by someone with a little

more experience than those who are having difficulty, there is no point in having your data processing experts provide this help.

Using slightly more experienced staff as resource personnel is not only an effective way of providing much needed assistance to beginners, it will also stimulate the resource personnel to expand their own knowledge and skill. Constantly developing new groups of resource personnel will also alleviate some of the problems associated with staff turnover. Since it is inevitable that some talented staff members will be offered jobs elsewhere after they become knowledgeable about microcomputers, it is best to build a system that automatically replaces them.

Recognizing and reinforcing the emergence of resource specialists who are available to help others on a voluntary part-time basis can lead to the rapid proliferation of microcomputer knowledge and skill throughout the organization. This approach will also build upon and provide organizational direction and support to something that is going to happen anyway. Because of their exitement about microcomputers and interest in sharing what they have discovered with their peers, some individuals will emerge naturally in this category. Others who are equally knowledgeable may be reluctant to share their expertise unless such a role is officially sanctioned by the organization.

The selection and training of resource personnel begins with a review of those survey respondents who expressed an interest in performing this function. A consultant should be able to assist you in identifying promising talent both within this group and from among other employees. It is important not to limit your thinking as to where microcomputer talent might be found within the organization. After a group of resource people have been identified, they should receive specialized training before the orientation training sessions begin. After the microcomputers arrive, additional resource talent will emerge as other staff members gain experience in using the equipment. The system for identifying and using resource personnel should be designed in such a way that additional talent is added to the organization's resource pool on a regular basis. Individuals acting as resource persons should be officially recognized by the organization and time given in providing assistance should be factored into their overall job responsibilities.

Some of the characteristics that you should look for in your attempts to identify resource people include the ability to use certain software, previous course work related to computers, knowledge about programming, owning a microcomputer, or having arranged to obtain an unofficial microcomputer for the office. Knowledge of a foreign language and musical ability are also indications that an

individual may enjoy working with computer languages. Natural curiosity about the technology, enthusiasm and interest, and ability to communicate effectively with colleagues are also important considerations. Make sure that your data processing personnel are included in this resource group, but focus their energy on providing assistance at the more advanced levels.

Training for resource personnel would begin with the delivery of the microcomputers to the agency. During the initial two month period when the equipment is available, each resource person would have a microcomputer assigned to them. The entire group of resource people would work together during the initial three days of their training which would concentrate on the use of word processing, an electronic spreadsheet, and a data base management system. Instructional materials would be developed for use in this training that included both quick reference materials and extended non-technical readings about the hardware and software being used. The resource people would also receive additional training designed to enhance their ability to train others to use the equipment and software. At the end of the initial three days of training, each of the resource people would take their microcomputer back to their home office or workstation.

For the next four weeks, the resource people would be released at least half time from their normal responsibilities with the understanding that they spend this time learning to use the equipment and software. The resource people would be encouraged to isolate themselves from their colleagues during their released learning time and should be provided with suitable office space where their regular workstations are insufficiently isolated. The resource people would also be encouraged to take the equipment home on weekends. During this four week learning period, resource personnel would have access to a telephone help line so that their questions and problems could be addressed. They would also get together as an entire group at least once each week with their equipment for additional group training.

At the end of the four week learning period, resource personnel would begin to train others in their section of the organization under the supervision of a consultant. Each of the resource people would be responsible for providing one supervised training session per week over a three week period of time for a groups of five to six people. Topic areas for the training would consist of orientation training in the use of word processing, electronic spreadsheet, and data base management software. This experience would give each of the resource people an opportunity to try out some of their newly developed expertise with the guidance and support of a consultant. Evaluation by both trainees and the consultant would be an important part of this supervised training.

At the end of the three week supervised training period, the microcomputers would be returned to normal usage within the organization. The resource personnel would continue to use the equipment, but not on the exclusive basis that was encouraged during their training period. After completion of their training, resource personnel would continue to provide training and support to their colleagues through the microcomputer support center. As their knowledge and skills expand, the resource personnel would receive further training so that they can function at increasingly sophisticated levels.

Establishing A Microcomputer Support Center

By the time that the orientation sessions begin, the microcomputer support center should be in place. The major purpose for such a center is to provide readily available in-house support for microcomputer users. The support center should be structured in such a way that it is responsive to all microcomputer users within the organization. An effective support center will perform the following functions: (1) provide preliminary problem determination support for hardware and software difficulties; (2) serve as the corporate contact with hardware and software vendors; (3) schedule orientation and other training sessions as needed; (4) provide instructional materials and program documentation for software; (5) coordinate the availability of in-house resource personnel who can answer software application questions; and (6) facilitate effective interaction patterns between microcomputer users and data processing personnel.

The support center would be managed by several full time staff members with most of the center's talent being available on a part time basis. The full time staff should have administrative skills and can begin operating the center with only a general knowledge of microcomputers as long as they are interested in learning and have access to expertise from consultants and agency resource personnel, particularly those in the data processing department. Such a non-technical orientation by the full time staff will emphasize the center's primary role as a broker of microcomputer related services for all personnel. It will also keep the center from becoming the exclusive territory of technical specialists who often have difficulty communicating with the majority of the non-technical users of microcomputers.

The key ingredient for a successful center is accessibility and responsiveness to the people in the organization who are using the microcomputers. If an organization has several locations, then satellite centers should be established as extensions of the central one so that help is available in every location. In those cases where resource personnel are initially scarce, access can be created through a microcomputer help line that anyone can reach on their telephone. Such an arrangement can be as simple as circulat-

ing the telephone numbers for those staff members who are at an advanced level in the use of specific software. As long as the number of calls for help is not excessive, resource people can respond effectively from their own workstations while using the software.

To avoid the proliferation of incompatible equipment and programs within the organization, decisions must be made as to the types of equipment and software that will receive support from the center. One approach would be to select several microcomputer vendors and accessories, as well as specific software that the center will support. If someone chooses to use another type of equipment or develops their own software program, it should be clearly understood that center personnel will not provide advice, repairs or service for these items.

This approach does not attempt to control all microcomputer use within the organization, it simply provides positive reinforcement for the use of certain types of equipment and software that have been judged effective in meeting the needs of the agency. The provision of free software, service, and support for selected microcomputers will serve as a major enhancement for people to use that equipment. At the same time, a system should be developed for periodically reviewing and approving additional software and hardware configurations since rapid changes will continue to occur in the field of microcomputers.

Awareness Training

Awareness training sessions would be conducted on a limited basis before the equipment arrives as a means of informing, generating interest, and responding to the questions and concerns raised by staff. These sessions can serve as an effective means for preparing staff members to be more receptive to the use of microcomputers when the equipment arrives.

After a brief overview of a microcomputer's capabilities, the instructor should be prepared to respond in a non-technical way to a wide range of questions. At the awareness stage of training, trainers should be particularly sensitive to the political implications of introducing microcomputers into the organization. It is also important that participant expectations regarding the immediate usefulness of microcomputers not be raised excessively during the awareness training since it will take time and effort for the staff to learn how to use the equipment once it arrives.

Orientation Training

Orientation training should occur after the equipment has arrived and is being used by staff with each training

session focusing on a specific software application. The orientation training is most effective when scheduled on a repeat basis so that personnel can select their priority software topic, invest time in learning how to use that software, and then sign up for a different software orientation session at a later point in time. This approach may mean that orientation sessions need to be conducted repeatedly over a six to nine month period so that staff members can proceed at their own pace in learning how to use the software options that are available.

The orientation sessions should concentrate on introductory level issues and emphasize actual use of the software and equipment by participants. Instructional material must be developed for each piece of equipment and software and should provide participants with a detailed operational checklist starting with directions on how to turn on the machine and load the software. Consultants and resource personnel should be careful not to overload participants with too much information; instead, these sessions should be structured so that the beginner starts using the microcomputer and then receives appropriate reinforcement and help. Wherever possible, resource personnel from the same building as the trainees should be present at an orientation sessions in order to provide continuity in support after the trainees return to their place of work.

Specialized Training For Selected Groups

Certain groups will need specialized training because they perform functions that require longer, more detailed training or because the work they will be doing is somewhat unique. Although resource personnel are certainly such a specialized group, their training is of such critical importance to the successful introduction of microcomputers that it has already been described in detail in an earlier section of this chapter.

Additional examples of groups in need of specialized training within a state education agency would include the following: (1) personnel who are responsible for training school teachers to teach programming in Basic or Pascal; (2) those who assist school system personnel in the review and selection of instructional software for schools; (3) staff responsible for reviewing school system proposals that include requests for the purchase of microcomputer hardware and software; and (4) personnel with monitoring responsibilities that are highly specialized and require familiarity with equipment or software that has been adapted for use in their area of specialization. In these cases the training would be longer, more intensive, and more specialized than that provided for staff members who are using microcomputers primarily as a tool that supports their regular administrative or professional responsibilities.

It is best to define the scope of potential specialized training quite broadly so that the center can be responsive to diverse staff needs as they emerge. At the same time, it is important that the center not encourage a proliferation of specialty areas among the staff since many of the functions that might initially be thought of as specialty areas can actually be handled quite effectively using software that is available off the shelf.

There probably will be a heavy staff interest in using the equipment once it arrives, and it may be appropriate to defer some of the specialized training until after the microcomputers are being used effectively for general administrative purposes. It is also important to remember that some of the specialized training may require the use of equipment that is quite different than that purchased for administrative usage (e.g., review of classroom instructional materials) and other specialized training can be carried out using less expensive equipment (e.g., many basic programming skills can often be taught on inexpensive home computers). Although the agency should eventually acquire equipment for use in all of these different specialty areas, it is important that usage priorities are established and followed carefully when the initial equipment order is delivered to the organization.

In this chapter we have provided an overview of issues that need to be considered in developing an organizational training and support system that will effectively integrate microcomputers into the workplace. Obviously, the elements of such a training and support system extend far beyond those issues that are addressed in developing effective microcomputer awareness training programs. Implicit within the development of awareness training programs is the assumption that increasing a person's understanding of what can be done with a microcomputer will eventually lead to actual use of the equipment. We suggest that such an eventuality cannot be left to chance, especially when it comes to the introduction of microcomputers.

CHAPTER X

CONCLUDING THOUGHTS

When the Institute began its first series of computer awareness training programs for state education agency staff in February 1982, we focussed the training exclusively on the use of mainframe computers and used a lecture and discussion format without any computer equipment available. By the time our most recent microcomputer awareness training session was conducted in November 1982, we had shifted our training focus to the use of microcomputers as professional and management workstations and had incorporated a major amount of hands-on experience into the training.

Many of the forces which were responsible for this shift in training emphasis from mainframe to microcomputers were unique to the set of events and circumstances that we have described in this monograph. Certainly the particular mix of people, their interaction patterns, and the history of organizational collaboration between the state education agency and the Institute are somewhat unique. In addition, a core of personnel in the state agency understood the potential benefits that could occur through the use of microcomputers and this core of knowledgeable people spent many hours persuading their colleagues to approach the topic with an open mind. Finally, when critical decision making opportunities appeared, key management personnel provided the decisive leadership that was needed to aggressively pursue the use of microcomputers for administrative applications within the agency.

In spite of the specific set of circumstances that were present in this situation, we feel that knowledge of our experiences will be helpful to those who are interested in developing microcomputer awareness programs in other organizations. As a result, we used the development of this monograph both as an opportunity to describe the events that took place and as a mechanism for organizing our reflections on the significant issues that we faced during this past year of awareness training.

The reader still faces the most difficult part of the task, that of modifying what he/she has learned from this and other sources so that the information is usable in varied organizational settings. In applying what you have learned about microcomputer awareness training, it is important to rely heavily upon the people who will eventually be using the microcomputers in the organization. They may not have much technical information about microcomputers at the beginning of the process, but their involvement is critical to your success.

The widespread use of microcomputers will create unforeseen situations of problems for some people in just about every organization. At the same time, the microcomputer will also

provide a marvelous opportunity for many people in these same organizations. For perhaps the first time in the careers of most adults, a new technology has come along that promises to increase the productivity of personnel while lowering costs during an era of declining resources. Appropriate use of this technology will create opportunities for the emergence of new leadership, a restructuring of obsolete organizational components, and the reawakening of dormant talent.

However, the inappropriate use of microcomputers in an organization can also result in problems and difficulties that will haunt an agency for years to come. Although some of these problems will be associated with decisions about what equipment and software to use, many more difficulties will emerge as a result of poorly developed training and support activities for the staff that will be using the equipment.

We hope that this monograph has been helpful to you in thinking through some of the training issues that your organization must address as you begin the process of integrating microcomputers into your operation.

APPENDIX A

GLOSSARY OF MICROCOMPUTER TERMS

BASIC Beginners All-purpose Symbolic Instruction Code. A programming language which is available in almost all microcomputers.

BIT A single switch-like space which can be either on or off. There are usually eight bits to a byte or character.

BYTE A unit of memory space that is usually composed of eight bits. One character code (e.g., a letter or number) can be stored in each byte.

CHARACTERS A set of elementary symbols such as those on the keys of a typewriter. These symbols usually include the letters A through Z, the decimal digits Ø throught 9, punctuation marks, operation symbols, and any other single symbols that the computer is capable of reading, storing or writing.

CHIP A miniature electronic device which stores or manipulates coded information. The introduction of the chip replaced thousands of larger circuits and devices.

COBOL Common Business Oriented Language. A higher-level (i.e., more like human language) programming language developed for business applications.

COMMUNICATION DEVICE Hardware used to connect a micro-computer with telephone lines and other communications media.

COMPUTER A device which can be instructed to compare, rearrange and mathematically operate on coded information.

COMPUTER ASSISTED INSTRUCTION (CAI) Software that uses programmed learning techniques to instruct students. Usually the student is provided with specific information on a topic, given a question with multiple choice options, and informed whether or not the selected answer is correct. Depending on the response, the student is then directed to the appropriate next step in the learning sequence.

C.R.T. A cathode ray tube; the technical name for a television picture tube.

CURSOR A special symbol that appears on the screen indicating the position where the next character will be displayed.

DAISYWHEEL PRINTER A letter quality printer with a print head that is shaped like a wheel with many spokes. Each of the spokes has a letter, numeral or symbol at the end that is hammered against the paper in a manner similar to that used by a regular typewriter.

DATA BASE MANAGEMENT A software program that enables the computer to store data in such a way that parts of information can be retrieved from the data base using a variety of different report formats.

DISK A round magnetizeable storage medium (similar to recording tape in how it records information) that is usually made of mylar with iron particles coating it. Also known as a floppy disk or flexible disk, it is usually 5 1/4 or 8 inches in diameter.

DISK DRIVE The hardware component where information is recorded on or played back from a disk.

DISPLAY DEVICE The means by which you can see the data that is in the main memory of the computer. Usually this is a television screen that is also known as a C.R.T. or monitor.

DOCUMENTATION Written and pictorial descriptions of hardware or software that explain how they work.

DOT-MATRIX PRINTER A device used to print information from the computer on paper using tiny wires that are poked through a ribbon to form characters with dots.

ELECTRONIC SPREADSHEET A software program used for managing numbers that is made up of horizontal rows and vertical columns where every intersection of a row and column can be designated by specific coordinates. The rows, columns and individual locations on the spreadsheet can be manipulated mathematically. Also known as a visible calculator.

FORTRAN A programming language developed for scientific applications.

GRAPHICS Software that enables the computer to construct images such as graphs, charts, and objects. Graphics can be displayed on either monochrome or color monitors as well as transferred to paper using various types of printers.

HARD COPY Output from a computer that is printed on paper.

HARDWARE The physical equipment that makes up a computer system.

INPUT Information that is put into the computer, usually through a keyboard.

INTERFACE A device or software which enables other devices to be connected to the computer and to each other.

K Usually refers to a thousand Bytes or characters of information. Derived from the metric Kilo.

KEYBOARD A device that is used to enter numbers, letters and other characters into the computer. Similar in appearance to a typewriter keyboard, but usually equipped with extra keys.

LANGUAGE A vocabulary of commands used to instruct a computer to carry out particular tasks.

LETTER-QUALITY PRINTER A device that can print information from the computer on paper at high speed with a quality of print comparable to that of a typewriter.

LOAD The process of copying software into the main memory of the computer.

LOGO A programming language that uses geometric designs on the screen to teach children about computers.

MAGNETIC TAPE A magnetizeable storage medium such as that found in cassette tape containers and large tape reels.

MAINFRAME COMPUTER Originally this term was used to refer to the main part of the computer, the central processing unit. In relationship to microcomputers, the term mainframe computer usually refers to a large, multi-user system with multiple chips.

MAIN MEMORY The volatile or temporary information storage place in the computer that is composed of switch-like devices which record information in bits and bytes.

MENU A listing of the task choices that are available within a program.

MICROCOMPUTER A computer which has its processor on a single chip. Also referred to as a micro.

MINI-COMPUTER A smaller and less expensive version of a mainframe computer.

MODEM A device which changes digital information into tones (modulates) and tones into digital information (demodulates) so that computers can communicate over telephone lines. The word modem is taken from the phrase Modulator/Demodulator. An acoustic coupler allows a modem to be connected to a standard telephone handset.

NETWORK CONTROLLER A communications device that enables multiple microcomputers to communicate among themselves.

OPERATING SYSTEM A collection of programs that manage interactions among the system components. Also known as DOS (Disk Operating System).

OUTPUT Information transferred out of a computer to an accessory for display, storage or printing.

PASCAL A structured higher-level programming language.

PROCESSOR The part of a computer that controls its operation and manipulates data. The processor is instructed to carry out tasks by a software program. It is also called a microprocessor or a C.P.U. (Central Processing Unit).

PROGRAM The operating instructions that are given to a computer in a form and syntax which the computer can recognize.

PROGRAMMER A person who devises instructions for a computer.

SECONDARY MEMORY Information storage media such as disks, mini-diskettes, and magnetic tapes that are slower than main memory but are able to store the information permanently.

SOFTWARE Instructions to the computer which are loaded into the computer's main memory on a temporary basis. Software tells the computer what to do, when to do it, and what data to use.

SYSTEM UNIT Typically a rectangular shaped container that is used to house the main memory, the secondary memory, and the processor.

TERMINAL A device used to enter data into and receive data from a mainframe or mini-computer. Terminals usually consist of a keyboard and a C.R.T. for the visual display of data.

WORD PROCESSING A program which enables the user to store and edit text on the computer.

WORKSTATION The physical location in an organization where an individual uses a microcomputer.

APPENDIX B

BIBLIOGRAPHY

Barry, Stephen T. "A Play Within a Play: Using the Computer to Teach About Itself." T.H.E. Journal (February, 1982).

Bell, Daniel. "Communications Technology--For Better or For Worse." Harvard Business Review (May-June 1979).

Bertoni, Phil. "Coziness on the Computer." The Boston Globe, February 19, 1981.

Bertoni, Phil. "Good Language of Command." The Boston Globe, February 17, 1981, p. 47.

Billings, Karen and David Moursund. Are You Computer Literate? Forest Grove, OR: Dilithium Press, P.O. Box 92, Dept. CT, 1979.

Computer Literacy: An Introduction. The University of the State of New York, The State Education Department, Center for Learning Technologies, Albany, NY 12234, 1982.

Computers for Everybody. Beaverton, OR: Dilithium Press.

Ellis, Clarence A. and Garry J. Nutt. "Office Information Systems and Computer Science." Computing Surveys, Vol. 12 (Association for Computing Machinery).

"ERIC Information Resources on Microcomputer Applications: Elementary/Middle/Secondary Education."

Friel, Susan and Roberts, Nancy. "Computer Literacy Bibliography." Creative Computing.

Handy, Charles. "Through the Organizational Looking Glass." Harvard Business Review (January-February 1980).

Hansen, Thomas; Klassen, Daniel and James Lindsay. "The Impact of Computer-Based Information Systems upon School and School District Administration." Journal of the Association for Educational Data Processing (Fall 1978).

Keen, P. G. W. "Information Systems and Organizational Change." Communications of the Association for Computing Machinery, Vol. 24, No. 1 (January 1981).

Kling, Rob. "Social Analyses of Computing: Theoretical Perspectives in Recent Empirical Research." Computing Surveys, Vol. 12 (Association for Computing Machinery.

Melmed, Arthur S. "Information Technology for Education: An Agenda for the 80's." T.H.E. Journal 7, no. 6 (November, 1980):46-48.

Mertes, Louis H. "Doing Your Office Over Electronically." Harvard Business Review 59, no. 2.

Micro Sift News, Vol. 1, No. 2 (October 1981). Northwest Regional Educational Laboratory, 300 S.W. Sixth Ave., Portland, Oregon 97204.

Mocciola, Michael. "Who Was Really First to Invent the Electronic Digital Computer?" The Computing Teacher, Vol. 8, No. 6.

Molnar, Andrew R. "Understanding How to Use Machines to Work Smarter in an Information Society." T.H.E. Journal 7, no. 1 (January, 1980):42-47.

Moshowitz, Abbe. Inside Information: Computers in Fiction. Reading, MA: Addison-Wesley, 1977.

Moshowitz, Abbe. The Conquest of Will: Information Processing in Human Affairs. Reading, MA: Addison-Wesley, 1976.

Moursund, David. Basic Programming for Computer Literacy. New York: McGraw-Hill, 1979.

Naiman, Adeline. Microcomputers in Education: An Introduction. Northeast Regional Exchange, 101 Mill Road, Chelmsford, MA 01824; Technical Education Research Centers, 8 Eliot Street, Cambridge, MA 02138, January 1982.

Nelson, Ted. Computer Lib/Dream Machines. Swarthmore, PA: Ted Nelson, Publisher (distributed by The Distributors, 702 S. Michigan, South Bend, IN 46618).

Rockart, John F. "Chief Executives Define Their Own Data Needs." Harvard Business Review(March-April 1979).

Sample, Robert L. "The New Photocomposers: Increased Speed and Diversified Capabilities." Administrative Management (November 1981).

Shear, Jeff. "The Computers Are Coming." Nutshell(1981-82): 61-68.

Steely, Don. "Instructional Design and CAI." The Computing Teacher8, No. 1:33-37.

Wallace, Beatson. "A Data Plan for the State." The Boston Globe, January, 22, 1981.